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Reply to 1680–1

Date November 16, 1988

TO: All Olympia FSL Staff

The PNW HISTORY COMMITTEE has sent the Lab. a copy of Robert Cowlin's history of research at PNW. This book will be kept in the library and available for all to read.

Eventually, the committee expects to have a summary for public distribution and also a supplement to bring the historic record to the present.

DEAN DeBELL
Director's Rep.

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Reply to: 1680-1 Date: October 27, 1988

Subject: Historical Report

To: Director's Representatives

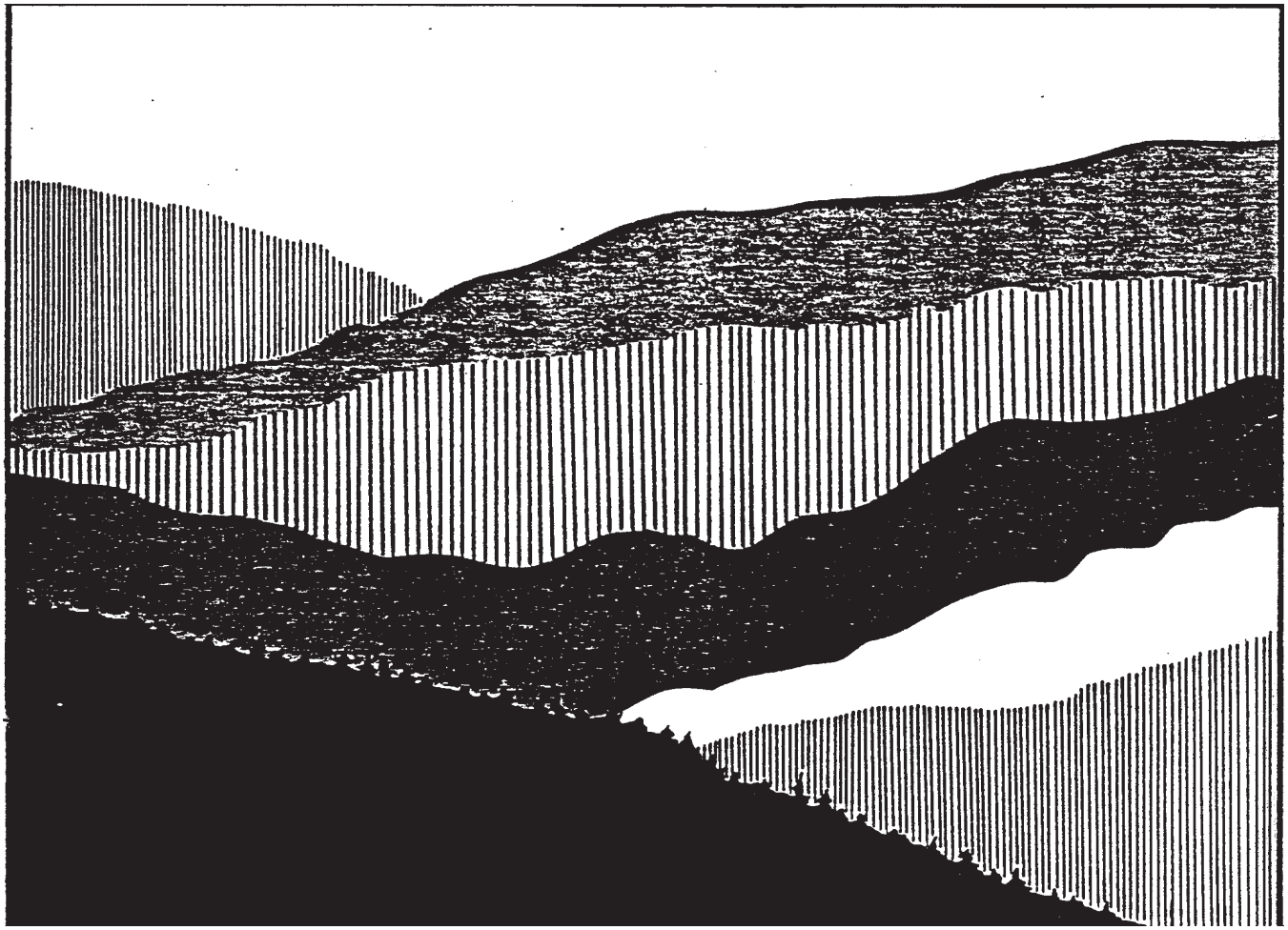
Here for use as a reference is a copy of Robert Cowlin's history of research at PNW. Copies have been sent to all PNW FSLs and several copies are available in the Director's Office and RIS. Please let colleagues at your FSL know where the book will be kept. Eventually, we expect to have a summary for public distribution and also a supplement to bring the historic record to the present.

PNW HISTORY COMMITTEE

Federal Forest Research in the Pacific Northwest

The Pacific Northwest Research Station

Robert W. Cowlin
October 1988



Preface

The primary purpose of this history is to record the scientific research of the Pacific Northwest Forest and Range Experiment Station and analyze its significance in the management and utilization of the total forest resources of this region[1] in the context of the national economy. In essence, the scope of Federal forest research in the Pacific Northwest during the period covered by this history includes activities of several other agencies of the Federal Departments of the Interior and Agriculture. As time passed, organizational changes consolidated the Pacific Northwest Forest and Range Experiment Station. In order to preserve historical integrity, the work of antecedent agencies will be reported under the contemporary organization name.

Furthermore, to outline the basis of knowledge for initiating and conducting Federal forest research programs in the region, earlier scientific investigations relating to the broad field of forestry will be described briefly. By way of background, early explorations of the North Pacific Coast and hinterland will be described.

A list of references examined will be given in the appendix of this document. No attempt will be made to present a bibliography of Station research or that of its antecedents. Such information is available in the Station library and in many other public libraries.

Neither will a complete list of Station professional personnel be included. Many will be named. Many more people not named contributed to the final products of research, the Station's publications as well as the authors. This group includes collaborators, junior professional assistants, technicians, computers, editors, clerks, stenographers, and business management people. In addition, many of the Station's major publications have been improved through technical review by other public and private professional people. Station advisory committees have also contributed to the success of the Station's programs. Public acknowledgment of the contributions of these people have been made currently in other media. Some of this group will be named in this document in connection with specific events of historical note.

The author's acknowledgment of personal sources of information and assistance in compiling and writing this history is shown in a separate section.

The author considers it appropriate to make a statement in this preface based upon historical fact tempered with personal observation and personal observation and opinion. The author joined the Station staff on November 5, 1929, and served continuously on it from that date until his retirement March 1, 1963. He has known intimately the three directors who preceded him, Thornton T. Munger, Stephen N. Wyckoff, and Dr. J. Alfred Hall, and his immediate successor, Philip A. Briegleb, who joined the Station staff in July 1929. Each of these men left his mark upon the character, growth, and success of the Station and its program. Their scientific contributions are well known to professional foresters and to many others who are members of various groups having occasion to use the Station's scientific forestry contributions.

Since this history is intended to cover Federal forest research in the Pacific Northwest, the reader should know that universities, colleges, State agencies, forest industries, and scientific groups and individuals have also contributed to the growing body of scientific forest knowledge relevant to this region. This is particularly true of later years.

1 For convenience, the Pacific Northwest is defined as comprising the States of Oregon and Washington. At times during its history, the official territory of the Pacific Northwest Station did not include the three northeastern counties of Washington; Spokane, Pend Oreille, and Stevens. Recently, these counties were officially added to the Station's territory as were the States of Idaho and Alaska.

One central fact is not always as well known and understood. The Federal Government's responsibility for scientific forest and forest range research was recognized before the Federal forest lands were set aside from the public domain in 1891 by Presidential proclamation as forest reserves. When the Division of Forestry was established in 1881 under the U.S. Department of Agriculture, research was considered one of its functions and this function was given statutory rank in 1886. Its activities were expanded in the late 1890's and in 1905, when the forest reserves were transferred from the U.S. Department of the Interior to the Department of Agriculture and renamed as National Forests, research was an established policy. June 1, 1915, the independent status of research was formally recognized by the creation of the Branch of Research, coequal in the Forest Service with National Forest administration in autonomy of action with direct responsibility to the Chief Forester. Under the aegis of Gifford Pinchot and Henry Graves, Dr. Earle Clapp was mainly responsible for this far-seeing action in establishing the principle of integrity and independence of forest research in the Forest Service. In brief, Forest Service policy in administering the National Forests and in its role of developing and enunciating broad programs and measures dealing with the total forest resources of the Nation places no constraints on the conduct of forest research and dissemination of research results. This does not imply that the Branch of Research does not consider the problems of managing public and private forest lands in developing and conduction its programs including the establishment of priorities. In fact, the advice of public and private forest-land managers and other concerned citizens has been consistently sought and used and research programs have been almost entirely problem solving in objective.[2]

In the author's opinion, the directors of this Station have adhered to the above criteria and have preserved the independence of forest research in administering the legislatively approved research programs in the Pacific Northwest.

2 This does not mean that some basic research has not been done by research scientists in the Forest Service, particularly in the period following World War II. Congress appropriates public funds for forest research by specific functions directed to problems of national and regional concern. Fiscal accountability limits the direction of research programs in requiring that they be purposive.

CHAPTER I. THE EXPLORATORY AND PIONEER PERIOD, 1792-1891

Archibald Menzies, a Scottish surgeon and naturalist, who came to the Pacific Northwest with Captain Colnett in 1786 and with Commander Vancouver in 1792, took cuttings and plant specimens back to England with him. On the Vancouver voyage, Menzies entered the Columbia River in a ship commanded by Lieutenant Broughton. In a longboat manned by some of the ship's crew, he went up the river 100 miles and collected twigs, needles, and cones of a conifer he called *Pinus taxifolia,* later classified as *Pseudotsuga taxifolia.* This nomenclature stirred a controversy many years later when the scientific name of Douglas-fir was changed in 1950 from *Pseudotsuga taxifolia* to *Pseudotsuga menziesii,* based upon historical research by Franco. Other specimens collected by Menzies were what are now known as Sitka spruce, *Picea sitchensis;* Western hemlock, *Tsuga heterophylla;* and western redcedar, *Thuja plicata.* Cuttings and seeds of many other tree species and other plants were taken back to England for propagation as well as the specimens which were placed in the Banks Herbarium in London for systematic classification and study. Unfortunately, the Menzies notes and descriptive material were evidently published in a number of places and not in a single work, thus probably accounting for some of the later confusion in nomenclature.

Lewis and Clark, in their overland exploratory journey to the mouth of the Columbia River in Oregon during 1805-06, collected plant specimens which were classified upon their return by Frederick Pursh, an Austrian botanist, and published in his "Flora Americae Septentrionalis" in 1814. Meriwether Lewis, although no botanist, was a careful collector, and when no specimens were collected he made precise descriptions and faithful drawings of the plant subject, and Pursh used these as well as the specimens in his classification and publication.

Sir William J. Hooker used Pursh's work as well as the Menziies collection in his "Flora Borealis Americana;" published in 1829-40.

David Douglas, another Scot, did much to enlarge the knowledge of forest plant life of the Pacific Northwest through his extensive overland trips through the Pacific Northwest in 1825. Douglas was largely self-educated and in early life showed a great interest in natural history. He was apprenticed to a gardener of the Scone Palace Gardens at the age of 10 or 11. Studying books on natural history impelled him to audit lectures by Sir William J. Hooker, Professor of Botany, University of Glasgow, Scotland. Through Hooker, Douglas was employed by the Royal Horticultural Society of London early in April 1823 and became a plant explorer. No doubt Hooker and Douglas were stimulated by the Menzies descriptions and collections to learn more about these fabulous Pacific Northwest forests. Hooker and Aylmer Bourke Lambert did much of the classification of the Douglas collection.

Dr. John McLoughlin, who established Fort Vancouver in 1824 as a trading post for the Hudson's Bay Company, was keenly interested in the flora of this region. When Thomas Nuttall, an English born naturalist who emigrated to this country at an early age, arrived at Fort Vancouver after an overland journey in 1834-35 with a brigade of trappers headed by Sublette and Wyeth, he was welcomed by Dr. McLoughlin. At that time, the resident physicians at the Fort were Dr. Meredith Gairdner and Dr. W. E. Tolmie, both protégés of Sir William J. Hooker and plant collectors as well as physicians. Nuttall and his companion John Kirk Townsend spent some time in the Willamette Valley. They had a wide range of interest in flora and fauna, including a special interest in ornithology, although Nuttall contributed many written works and lectures upon the plant life of this region. His major written work was "North America Sylva," published in 1849.[1]

1 The Michaux, *pere* and *fils,* commenced this work in 1810-13 covering the eastern States, eastern Canada, and Nova Scotia. Nuttall enlarged and supplemented it, covering the western States as well as the eastern States.

Soon after the Douglas and Nuttall travels in the Pacific Northwest, the tide of emigration westward over the Oregon Trail commenced. By 1844, a sawmill was producing lumber in Oregon. A year later, another sawmill was operating on the Puget Sound. The superior qualities of the wood from these forests were easily recognized by the settlers and the Yankee sea captains. The discovery of gold in California in 1849 and a short time later in southern Oregon provided a commercial market and a flourishing lumber industry was founded. The Sandwich Islands and the Far East provided other markets. The Columbia River, Puget Sound, and fine coastal harbors provided easy access to dense forest stands on comparatively gentle topography. The fame of Douglas-fir, or Oregon pine as it was commonly called in the trade, as an all around construction material spread and the attention of lumbermen from New England and the Middle Atlantic States turned to the Pacific Coast as signs of imminent exhaustion of timber supplies in those regions became evident.

Construction of the transcontinental railroads to the Pacific Coast in the second half of the 19th century hastened the settlement of the Pacific Northwest. In the middle of the century, the survey crews seeking competitive routes across the continent customarily were accompanied by botanists who reported in some detail on plant life for agricultural and timber purposes as a measure of potential freight traffic and to assist the promoters of the railroads in convincing capitalists to finance construction.

The public land laws and the temper of the times made it simple to acquire agricultural and timber lands from the public domain for settlement and speculation. The railroads were acquiring large blocks of public land bordering their rights-of-way as grants from the Federal Government. Many abuses of the public land laws followed and the Pacific Northwest had its share; in fact, Oregon became notorious for land frauds. At the same time, the “conservation of natural resources movement,” chiefly centered in New England and the Middle Atlantic Coast States, began to develop. Dr. Franklin B. Hough was a spearhead in this movement. Employed as a forest agent in the Department of Agriculture in 1876, his investigation into the forestry problems and the public land situation expanded in scope. Congress gradually increased appropriations to carry on his work.

In 1881, the Division of Forestry was established in the Department of Agriculture. It was given permanent statutory rank in 1886, and Dr. Bernard E. Fernow, a Prussian-trained forester, was placed in charge. Forest research was an officially recognized function of this agency. March 3, 1891, Congress authorized the creation of Federal Forest Reserves from the public domain. This action can be credited in part to the professionalism and persuasiveness of Dr. Fernow. The Director of the U.S. Geologic Survey was directed to survey the lands designated as Federal Forest Reserves and the lands were placed under the administration of the General Land Office, Department of the Interior.

Fernow, in his capacity as Chief of the Division of Forestry, emphasized the need for strengthening scientific forest research. He obtained the services of George B. Sudworth, Frederick V. Coville, and Filibert Roth, all trained scientists, not long after assuming office in 1886.

Roth, born in Germany in 1858, began his scientific education including plant studies early in primary and secondary schools in Germany and Switzerland. The Roth family migrated to the United States early in the 1870’s, settling in Ann Arbor, Michigan. As a teenager, Roth worked in sawmills in Wisconsin, and at age 16 he went to the Rocky Mountain area working as a trapper-cowboy and in other frontier occupations. He returned to Wisconsin in 1883 to work in the woods and sawmills and to teach school. He entered the University of Michigan in 1885, studying botany and forestry under Professor V. M. Spalding. While at the university, Roth under Spalding’s direction and at the instance of Fernow commenced studies in wood technology. In 1890, he joined the Division of Forestry as an assistant to Fernow in charge of technical studies of wood properties or timber physics as it was labeled.

George B. Sudworth, a graduate of the University of Michigan in botany, joined the Division of Forestry soon after Fernow took charge, specializing in forest dendrology which became his lifetime career. His contributions were most valuable to the development of forest research on the Pacific Coast.

Frederick V. Coville, another botanist whose major interest was forage plants, was in the Division of Botany, which had been established in the Department of Agriculture in 1868. It is not clear if Coville was formally attached to Fernow's division or not. Regardless of that, he worked closely with Fernow and his work contributed much to forestry throughout the West.

About the time Fernow was attempting to revitalize the Division of Forestry another forestry career, that of Gifford Pinchot, was commencing and was destined to have tremendous influence on all aspects of forestry and other natural resource development in the United States.

Gifford Pinchot first became interested in forestry in 1885 immediately before matriculating at Yale University. William H. Brewer, Professor of Agriculture at Sheffield Scientific School, stimulated and developed Pinchot's interest and understanding of forestry during his four undergraduate years at Yale. In his senior year, Pinchot sought the advice of Fernow among others regarding a career in forestry. Fernow advised Pinchot to regard forestry as an avocation not a vocation, apparently because Fernow considered forestry impracticable in the United States under then existing conditions. In spite of this, Pinchot elected to go abroad and enrolled in the French Forest School at Nancy in November 1889. During the following year, Pinchot supported his studies at Nancy with extensive travels and observations in Great Britain, France, Switzerland, and Germany. He returned home at the end of 1890 with a firm determination to put forestry in practice in the United States. His first actual job was examining and reporting in 1891 on the forested lands in the mid-Atlantic States of the Phelps Dodge Corporation, whose major activity was mining. At the same time, he was using the public forum and appraising political opportunities to achieve his goal of putting in practice professional forest management of this Nation's great natural resource.

Fernow and Pinchot had much in common in their background and dedication to forestry as a profession. Both had a family heritage of many generations of property ownership and wealth; one in the Old World, the other in the New World. They chose different avenues to attain a common objective; professional management of the Nation's forest resource. Fernow's ultimate career was in forest education in the universities of this country and Canada. Pinchot founded his career on public service and political action, a natural choice considering his ready access to people with power to promote progressive forest legislation at the Federal and State levels. Furthermore, by nature Pinchot was a militant advocate, articulate and bold in taking action in support of his convictions.

From reading their writings and biographies, one gets the impression that both these men had a pragmatic view of scientific forest research and were interested mainly in the results of research to support their rationale and policies rather than the methodology of scientific inquiry. Fernow apparently had given more thought than Pinchot to the scope of forest research, and in 1887 prepared a comprehensive outline of a plan for systematic forest research. No details of how this might be implemented were given, not unusual considering the frame of reference under which it was prepared.

An interesting note is that at his own expense Pinchot accompanied Fernow in 1891 on an inspection trip down the lower Mississippi valley viewing hardwood forests of this area in late 1891 or early 1892. Despite the fact that Fernow was the mentor, differences in personality traits appeared which probably formed the basis for future conflicts of opinion.

CHAPTER II. THE FOUNDING PERIOD OF FEDERAL FOREST RESEARCH, 1892 TO 1924

The early part of this period was characterized by fraudulent preemption of the public lands, catastrophic forest fires in the Lake States and the West, and an increasing flow of information on the condition of the Nation's forest resource. Public interest and concern was manifested by growth of forestry departments by a number of States, activities of the American Forestry Association, and organization of several State forestry associations. There were a number of forums for forestry leaders such as Fernow and Pinchot and conservationists such as Charles S. Sargent, John Muir, William H. Brewer, Frederick L. Olmstead, Wolcott Gibbs, and Sir Dietrich Brandis to express their views and concern.

Despite these activities, many people still considered our forests as inexhaustible and a bounty of Nature to be exploited without restraint. Some legislators and public officials in State and Federal Governments began to advocate governmental action and a number of proposals for legislative action were made.

In 1892, under the Creative Act of 1891, President Benjamin Harrison set aside from the public domain the Yellowstone Park Timberland in Wyoming. It contained more than a million and a quarter acres and was the first of the designated Federal Forest Reserves. Other forest reserves in Harrison's administration and in Grover Cleveland's which followed included the Cascade Forest Reserve in Oregon and the Washington Forest Reserve in that State. However, by the end of 1896, there was only a total of 17.5 million acres in the federal reserves. On February 22, 1897, near the end of his second term, Cleveland set aside by a dramatic proclamation 13 additional reserves totaling 21.3 million acres. This aroused a storm of protest, particularly in the western States. This action, on the other hand, gained the approbation of conservation groups and forestry spokesmen, stimulating them to greater public activity.

After much political maneuvering, the Organic Administration Act of June 4, 1897, was enacted by Congress as an amendment to the Sundry Civil Bill of that date. It authorized the Secretary of the Interior to protect and administer the public forest reserves and to issue rules and regulations to that end. It also authorized a survey of these lands by the U.S. Geological Survey and appropriated $150,000 for that purpose. Now for the bad news; this same amendment suspended the reserves created by Cleveland on February 22, 1897, until March 1, 1898. In that form it was signed into law on June 4, 1897, by President William McKinley who succeeded Cleveland.

Pinchot was employed a few days after June 4, 1897, by Secretary of the Interior Bliss as a confidential forest agent to examine and report on the suspended reserves. He was also to develop a plan for the establishment of a "Forest Service." Pinchot, accompanied by his brother Amos and a friend, started for the West on July 10 of that year. He covered a good part of the forested portions of the West on this trip during the summer and fall of 1897. A considerable time was spent, most of it on foot or on horseback, in the Washington Cascades and Olympic Mountains. There is no record of field trips by Pinchot in the Oregon Cascades at this time. However, he was in Portland and talked with the publisher and editor of the "Oregonian." He also made some contacts with the publisher and editor of the Spokane "Spokesman-Review" and the Seattle "Post Intelligencer" to gain support for his forestry views and actions. At several points on this trip he was accompanied by Henry L. Stimson, Henry S. Graves, Henry Gannett, and F. H. Newell of the Geological Survey, and C. Hart Merriam, Director of the U.S. Biological Survey. Two of these men, Gannett and Merriam, were responsible later for notable contributions to the body of scientific knowledge of Pacific Northwest forests. Of great importance was the intimate knowledge Pinchot

gained on this trip[1] of the forests of this region and the advances he made in local public acceptance of forestry through press interviews and personal talks with prominent people.

Returning from his western trip in November 1897, Pinchot commenced preparation of his report, which ended his assignment as a confidential special agent in the Department of the Interior.

Appropriations were provided to employ a force of forest inspectors, supervisors, and rangers to implement provisions of the Act of June 4, 1897. The Commissioner of Public Lands was placed in overall charge of this force. Unfortunately, most of the men appointed were either political hacks or persons of no forest experience. The first few years in the history of the reserves was a sorry chapter in American forestry. Unregulated grazing and timber trespass continued practically unabated and fire protection efforts were weak and ineffectual. There were a few exceptions in the caliber of the men appointed; one of these was E. T. Allen, appointed as a forest ranger in the State of Washington 1898. His later prominence and leadership in western forestry draws attention to his early history. He was born in New Haven, Conn., on December 26, 1875, the son of a Yale University professor. His father, becoming disenchanted with life in the East and growing lack of solitude there, moved his family West in 1885 and settled on the lower slopes of Mount Rainier in Washington. E. T. Allen had no actual school training and was educated at home. His family were people of culture and he received not only a classical education but also one closely related to nature.

Mr. Allen, Sr., had a herbarium in his home which, according to one account,[2] contained specimens of 116 botanical families and numerous genera and species. E. T. Allen was a man of personal charm, highly literate, and a persuasive speaker, including poetry as well as professional writing in his literary products. His early forest observations in a period when forest fires were numerous and uncontrolled probably were a motivating force in his later notable contributions to organized fire protection in the western forest regions. In 1898, he was appointed as a forest ranger on the forest reserves in the Department of the Interior. In 1899, he joined the staff of the Division of Forestry, U.S. Department of Agriculture, as a field assistant on special investigations in the State of Washington.

In the years since it was established in 1881, the Division of Forestry,[3] meagerly financed, had been struggling on a campaign of research, information, and education to awaken the public to an awareness of the serious nature of the forestry problem and to promote regulated management practices on public and private forest lands.

Fernow resigned as Chief of the Division of Forestry June 30, 1898, to organize and head the New York State College of Forestry, Cornell University Ithaca, N.Y., which was the first professional forest school of degree-granting status in the United States.[4] Under Fernow, the Division had laid the foundation of a program of research, and important original studies had been made in timber physics, dendrology, tree planting, phenology, and forest biology. In addition, much statistical information on forest conditions and wood products had been

1 In the summer of 1896, on an earlier trip to the West with the Forest Commission of the National Academy of Sciences, Pinchot passed through Oregon spending some time on a side trip to Crater Lake and Klamath Falls. At the same time Henry S. Graves was making a more detailed examination of the Cascade Forest Reserve in the Oregon Cascades.

2 From papers on file at the Oregon Historical Society, Portland, Oreg.

3 First functioned as a Division; given Bureau status in 1901.

4 Prior to this date, several eastern and midwestern universities offered single forestry courses, usually in the botany departments. In the Pacific Northwest, the University of Washington offered a course in the 1894-95 academic year. In the following year, it was taught by Edmund S. Meany, a notable historian. In 1897, the Biltmore School was opened on the Vanderbilt estate in North Carolina under Dr. C. A. Schenck, a prominent German forester. It offered a 1-year course and closed in 1913. In 1908, Professor E. R. Lake of the Department of Botany gave a course in forestry at the Oregon Agricultural College.

collected. However, little progress had been made in convincing the private timber-land owners and State and Federal Governments to apply this knowledge and develop working plans for mangement of their forest lands.

Fernow, trained in European political economy and forest conditions, apparently could not adjust to the political and economic conditions of this country. Also, he was criticized by some people for a preoccupation with studies of little early utility, such as weather modification studies.

The first comprehensive forest investigation [5] made in the Pacific Northwest by the Division of Forestry under Fernow was conducted by Frederick V. Coville. This work was done in the field in 1897 and consisted of a study entitled "Forest Growth and Sheep Grazing in the Cascade Mountains of Oregon." The results were published in 1898 under that title in U.S.D.A. Division of Forestry Bulletin No. 15. Coville described the sheep industry, listed and described the principal forage plants used by sheep in this area, evaluated the effects of overgrazing, and made a thorough analysis of the fire situation. He concluded that fires were more damaging than overgrazing to the Cascade mountain forests and discussed the causes of fires and Oregon and Federal fire laws and the relation of sheep grazing to fires. He also discussed the relation of forest fires to water supply on the eastern slopes of the Cascades. He recommended remedial measures after discussing the pros and cons of exclusion of sheep or abolition of the Cascade Reserve, two extreme measures which had been proposed by some advocates.

Coville proposed a new system of regulation, including protection of sensitive scenic or watershed areas, such as Crater Lake and Bull Run, by exclusion of livestock and issuance of special use permits to stockmen containing specific protective conditions.

The Bureau of Plant Industry, U.S.D.A., conducted a number of range studies in the West at the beginning of the 20th century, including one by David Griffiths reported in 1902 by Bulletin No. 38 of the Bureau titled, "Forage Conditions and problems in Eastern Washington, Eastern Oregon, Northeastern California, and Northwestern Nevada."

In the summer of 1899, Dr. A. D. Hopkins, at that time Professor of Economic Entomology at the University of West Virginia, made a 2-month trip to the three Pacific Coast States and Idaho. In this short time, Hopkins collected 4,563 insect specimens and took 760 notes. Later work in this field of study confirmed his description of the important forest insect problems of the Pacific Northwest.[6] In April 1903, Dr. Hopkins sent H. E. Burke, a member of his staff, to Hoquiam, Wash., where a temporary field station was established.[7] In 1891, large areas of western hemlock and Sitka spruce stands had been defoliated in the vicinity of Grays Harbor by the hemlock looper. Investigation of this epidemic was assigned to Burke. Other problems were black check in hemlock wood believed to be caused by a maggot or insect, bark weevils infesting spruce and Douglas-fir reproduction, and wood-boring insects. The hemlock looper epidemic had subsided long before Burke's arrival and apparently little study was given this insect. However, Burke completed the study of black check in hemlock which was published in U.S.D.A. Circular No. 61, "Black Check in Western Hemlock."

July 1, 1898, Gifford Pinchot was made Chief of the Division of Forestry, succeeding Fernow. For several years prior to his appointment, Pinchot had been successful in preparing working plans for management of large private forest-land ownerships and for some State forest preserves. One example was the Biltmore forest estate of

5 Some writers have described this as the first "scientific" investigation in the Pacific Northwest. In a more enlightened use of the term "scientific," it would better be termed an extensive reconnaissance or survey.

6 In 1902, the Division of Forest Insect Investigations was established in the Bureau of Entomology, Department of Agriculture, and Hopkins was appointed its first chief. He held this position until 1923 when he was succeeded by Dr. F. C. Craighead.

7 This station, which was occupied only during the field seasons of 1903, 1904, and 1905, was moved to Palo Alto, Calif., the following year.

George Vanderbilt in North Carolina. In this work he was assisted by Henry Solon Graves who, like Pinchot, was a Yale University graduate with postgraduate forestry training in Europe. Pinchot and Graves were not only intimate personal friends but their professional careers were linked closely for half a century.

Fernow, in his "History of Forestry," describes his successor as "young, ambitious, aggressive with some knowledge of forestry acquired in Europe, and with influential connections and a large fortune he easily secured the first need for effective sowing of the well-plowed field before him—appropriations."

When Pinchot took office as Chief [8] of the Division of Forestry, he brought with him *as* his principal assistant Henry S. Graves, who was placed in charge of the Section of Working Plans. Roth left soon after to join Fernow on the faculty at Cornell. However, Sudworth remained with the Division in the Section of Special Investigations to carry on his dendrology studies. A third section in the Division was that of Tree Planting in charge of J. W. Tourney.

Pinchot affirmed Fernow's description of him by effectively gaining increased appropriations from Congress. Within a year from the time he took office, the personnel of the Division had increased from 61 to 123.[9]

In 1899, under the general category of "studies of commercial trees," two studies were commenced in the Pacific Northwest under the leadership of Alfred Gaskill. This work was to prove highly significant to research programs in this region and was a forerunner of later studies which were fundamental to professional forest management practices on private and public forest lands. These were called the Red Fir (Douglas-fir) and Western Hemlock Studies. Timber measurement data were taken in the field during the summer and fall of 1899 and 1900 in the southern and central Puget Sound and Grays Harbor-Willapa Harbor sections of western Washington. Stem analyses and volume measurements were made on logging areas. These included lands of the St. Paul and Tacoma Lumber Co., the Simpson Timber Co., and the Dobson Logging Co. among others not as readily identified. Tree measurement cards of these studies are preserved in the files of the Pacific Northwest Forest and Range Experiment Station. Names of the field crew were not located, but all the cards were initialed by the field observer who numbered a dozen or more. One was known to be E. T. Allen; others could not be readily identified. All or most of the crew were apparently student assistants or trained men, judging from use of scientific names, handwriting, and language. Results of the western hemlock study were published in 1902 as Bulletin No. 33, Bureau of Forestry, U.S.D.A. "The Western Hemlock," by E. T. Allen. The subjects covered were silvical characteristics, insect and disease enemies, wood properties, volume and yield, manufacturing, logged-off lands, and bark harvesting and tannin extraction considerations. Evidently, in addition to the two seasons of fieldwork, a large amount of "library research" had to be done to cover such a wide range of topics. Allen had undoubtedly made many observations in the field on the subjects listed above, but conducted no systematic studies other than the mensurational ones. In his discussion of logged-off lands, he cites the burden of property taxes and the hazards of fire as deterrents to holding private forest land for second generation harvesting. Taxation and fire prevention and control were to be Allen's major interests for the remainder of his career.

No record could be found that the results of the red fir (Douglas-fir) study was ever published, and no explanation could be located for failure to publish. A manuscript of the report, also authored by E. T. Allen, is in the Pacific Northwest Station library lacking illustration and tables although space was left for tables and graphs and reference is made in the text to them.

The advent of the 20th century signaled far-reaching changes in Federal forestry activities. Pinchot's success in obtaining increased appropriations broadened the scope of the Division of Forestry. Hampered by lack of personnel trained in professional forestry, Pinchot took action to increase forest educational facilities in this country.

8 Five days after his taking office, his title was changed to "Forester" by order of Secretary Wilson of the Department of Agriculture.

9 No breakdown of this staff could be found, but apparently it includes not only clerical help and field assistants, but also collaborators, many on college faculties.

In 1900, a forest school was formed at Yale University largely through the efforts and financing of the Pinchot family. Henry S. Graves and J. W. Tourney left the Division of Forestry to form the nucleus of the Yale Forest School faculty and Graves was the first dean.

Pinchot, in his administration of the Division of Forestry (and the Bureau) oriented the program toward early attainment of professional management of the Nation's forest lands, giving relatively less attention to scientific research. However, owing to increased appropriations, the research program continued to gain in strength. Pinchot's objective of professional forest management clearly involved political considerations and was targeted toward early transfer of administration of the Forest Reserves from the Department of the Interior to the Department of Agriculture. This goal was to be reached relatively soon with Theodore Roosevelt's succession to the presidency.

In 1902, Sudworth's "Check List of North American Trees" was published as Bulletin No. 17 of the Bureau of Forestry. In the same year, Bulletin No. 34, "History of Lumber Industry in the Pacific Northwest," was also published by the Bureau. The dramatic growth of the industry in the first few years of the new century called attention to the urgency of learning more about the Pacific Northwest forests and their economic potential. Congress had discontinued the timber physics study programs in 1896 by appropriation act language characterizing it as "not germane to work of the Division." This program was resumed in 1902 by initiation of a cooperative program of the mechanical properties of important woods with several universities, and the first study on the Pacific Coast was initiated at the University of California in Berkeley in April 1903 under direction of Loren H. Hunt, an engineering graduate of the university. The California study commenced testing of several Pacific Coast woods, including Douglas-fir and western hemlock.

During 1903, the store of knowledge concerning the nature and extent of the Federal forest lands in the Pacific Northwest was greatly increased by publication of "Forest Conditions in the Cascade Forest Reserves—Oregon" by the Geological Survey, Department of the Interior, Professional Paper No. 9, Series H, Forestry 6. Although the work was done under direction of Henry Gannett, five men—H. D. Langille, Fred G. Plummer, Arthur Dodwell, Theodore F. Rixon, and John B. Leiberg—each covered roughly one-fifth of the area extending from the Columbia River on the north to the Oregon-California border on the south. The size of the area considered, the five men included a wealth of detail in the field observations and their written reports. The subjects covered included topography, geography, climate, land class (forested, burned, open, logged, cultivated, water, barren, and glaciers), estimated timber stand by species, forest pests (selective only), water supply, and roads and trails. The present and probable utilization of the timber resource, forest fire problems, and need for reforestation were also discussed in the report.

One of these men, H. D. Langille, was to take an active part in forestry matters in the Pacific Northwest for many years following.

The Division of Forestry had commenced an educational program consisting of exhibits at various expositions which flourished around the end of the 19th and beginning of the 20th century. Generally they consisted of maps, colored glass transparencies, and bromide photographic enlargements until the Louisiana Purchase Exposition in St. Louis, Mo., in 1904 when timber-testing exhibits were added. Upon its close late in 1904, a part of the forest exhibit from the St. Louis Exposition was shipped to Portland, Oreg., for the Lewis and Clark Centennial Exposition which opened June 1, 1905. J. B. Knapp, a 1904 civil engineer graduate from Purdue University who had conducted timber tests at St. Louis and assisted in the management of the exhibits there, was placed in charge of the wood utilization and timber-testing exhibit at Portland. These were housed in a Forestry Building, which was an imposing structure of wood. The solid walls were constructed of large Douglas-fir logs and the cathedral-like interior had 52 large Douglas-fir log columns, 4 to 5 feet in diameter, extending some 54 feet from the floor to the ceiling. The building had 5,600 square feet of floor space devoted to a greatly expanded forestry exhibit. In addition to the customary photos, transparencies, maps, etc., it included wood specimens and timber-testing equipment. Wood preservation (creosote) demonstrations were also conducted, probably on the

building grounds. Outside exhibits also included logging equipment and machinery. This exhibit attracted nationwide attention and upon the close of the exposition, the building and part of the exhibits were retained by the City of Portland as a permanent attraction[10] until destroyed in 1964.[11]

Knapp conducted mechanical wood property tests of Douglas-fir, Sitka spruce, and western hemlock at the Lewis and Clark Exposition to determine strength factors for the design of timber structures. At the close of the exposition, he moved the testing equipment to the Engineering Department of the University of Oregon where the tests were continued for another 2 years.

In 1905, tests of western hemlock for structural purposes and Sitka spruce, western hemlock, and red cedar for crossties and telephone poles were initiated at the University of Washington in Seattle. This testing laboratory was installed by Rolf Thelen and carried on by O. P. Goss and others for a number of years.

After the conclusion of the timber-testing studies at the University of Oregon in 1907, Knapp prepared a report, “Properties and Uses of Douglas-fir” published in 1911 as Bulletin No. 88 of the Forest Service. In the spring of 1909, Knapp installed a Forest Service exhibit of timber testing and wood utilization at the Alaska-Yukon Pacific Exposition at Seattle, Wash.

Other forest studies on the Pacific Coast were being carried out on a small scale from Washington, D.C. By 1904, Pinchot had organized the investigative work under two sections, Forest Products and Dendrology, and in 1905 a section of Silvics was added.

On February 1, 1905, Congress authorized the transfer of the Forest Reserves to the Department of Agriculture from the Department of the Interior. The name of the Bureau of Forestry was changed to the Forest Service and administration of the Forest Reserves, which thereafter were known as the National Forests, became its major responsibility. All the personnel of the Forest Service was classified under the Civil Service at the end of 1904.

Dendrology studies during 1904 and 1905 included a study of tan bark oak; otherwise, little was done on Pacific Northwest species, although Sudworth probably was collecting dendrological material on many other Pacific Coast forest trees from a number of sources. Major work. of this section at this time apparently was in osiery.[12] This work was evidently done in a number of locations throughout the country; it seems to have been of little import to the Pacific Northwest.

In 1907, range management research using scientific methods was initiated in the Wallowa Mountains by A. W. Sampson assisted by G. A. Pearson. Both of these men were graduates in botany of the University of Nebraska and had studied under Frederic E. Clements, a noted plant ecologist, at that institution. Sampson was appointed as an assistant plant ecologist in the Forest Service in the early summer of 1907. The objective of the Wallowa

10 From time to time after the Pacific Northwest Forest Experiment Station was established, Station personnel made inspections of the building for wood decay and made recommendations for repair or replacement of unsafe members.

11 Exhibits housed in the building were a total loss. Some outside exhibits were saved and now form a part of the exhibits at the Western Forestry Center in Portland.

12 For those who wish to add a word to their vocabulary, “osiery” is basket willow culture and use.

study was the revegetation of overgrazed subalpine grasslands. For years, grazing by domestic livestock had been unregulated on the forest ranges of the Federal Forest Reserves. The Wallowas had a history of grazing by large bands of sheep commencing in the 1880's. Sampson installed a number of vegetation plots which were photographed and measured. An objective of the study was to test the principle of deferred rotation grazing. Sampson studied these plots during the period 1907-11, but the major fieldwork was done in 1907-08. In 1908, Sampson reported on this work in U.S. Forest Service Circular 158, "The Revegetation of Overgrazed Range Areas," and in 1909 in U.S. Forest Service Circular 169, "Natural Revegetation of Depleted Mountain Grazing Lands." It is believed that Sampson's Wallowa study was the "first scientific range management study on the National Forests."[13] About the time Sampson was making his study, James J. Jardine[14] made a study of herderless sheep grazing in the Billy Meadows pasture in the Wallowas. His study was reported in 1909 in Circular 178, "The Pasturage System for Handling Range Sheep," U.S. Forest Service.

At the conclusion of Sampson's field studies and report preparation during 1907-11, he was transferred to Utah to open the Great Basin Experiment Station in 1912 on the Manti National Forest and was named its Director.

1908 was an eventful year in Forest Service research and in National Forest administration. At that time, Raphael Zon was head of the Section of Silvics in the Washington Office of the Forest Service. Zon[15] studied under Fernow at Cornell University and also had studied in the classical gymnasium of Russia, obtaining the equivalent of a degree in biology before emigrating to the United States in 1898. Also in the Washington Office at that time were Earle H. Clapp, who had also studied under Fernow at Cornell, and Samuel T. Dana who was Zon's assistant. All of these men were strong supporters of expanding forest research programs. For a year or two prior to 1908, the Section of Silica under Zon had been reviewing past work, systematically organizing available investigative forest data. Establishment of permanent sample plots for continuing silvical studies was commenced about this time. In 1908, Zon, supported by a group of other forest research personnel, proposed a plan for decentralizing research by establishing a series of Forest Experiment Stations on the National Forests.

The first Forest Experiment Station was established at Fort Valley, Ariz., on the Coconino National Forest, and work commenced in 1908 under the direction of G. A. Pearson, who was transferred to that position from the range studies underway in the Wallowa Mountains. This Station was formally established January 1, 1909.

July 1, 1908, a plan for reorganizing the administration of the National Forests was effected. Prior to that time, general administration was centralized in Washington, D.C., and controlled in the field through six inspection districts. The new plan established six districts, each in charge of a District Forester headquartered in the field with a staff whose functions paralleled those of the Chief Forester in Washington and his staff. The headquarters of District 6 was located in Portland, Oreg., and E. T. Allen was appointed as the first District Forester. Allen had left the Bureau of Forestry in 1905 to become the State Forester of California. He rejoined the Forest Service in 1907 as a forest inspector. The work at the District Office was organized under the four branches of Operation, Grazing, Products, and Silviculture, each under an Assistant District Forester. Investigative work as well as administrative was done by District Office personnel in grazing and silviculture. The latter office included a section called Silvics which conducted many research activities. The Grazing branch was under the direction of T. T. McKenzie.

13 Dr. A. W. Sampson (B.S. 1906 and M.S. 1907, University of Nebraska, and Ph.D. (Plant Ecology and Climatology) George Washington 1917) revisited these plots in 1955. Other range research men have studied them and reported on them at varying times. Continued photographing of them is being done and observations will be reported by this station.

14 In 1910, the Office of Grazing Studies was established in the Washington Office of the Forest Service, thus recognizing range research as an integral and important part of the forest research program. James J. Jardine was placed in charge. He left in 1920 to become Director of the Oregon Agricultural Experiment Station and was succeeded by W. R. Chapline, who held that position until 1952 when he retired. Jardine later returned to head the Office of Experiment Station, U.S. Department of Agriculture. He was long a strong supporter of forest research.

15 Zon was the second student to enroll in forestry at Cornell, receiving the degree of Forest Engineer (F.E.) in 1901. That same year he was employed as a student assistant at the Bureau of Forestry.

The work of the branch of Products was largely investigative in nature, including wood products research and collection of data from the lumber industry such as annual lumber production. J. B. Knapp was made Assistant District Forester in charge of this office. F. E. Ames was appointed Assistant District Forester in charge of Silviculture, a position he held for many years.

Thornton T. Munger, who was graduated from the School of Forestry at Yale University in 1908, joined the Forest Service July 1, 1908, in the Washington Office of Silvics under Zon. For 2 months he worked in Washington revising silvical leaflets and working over phenological observation data. At the end of this short period, Munger was sent to Oregon to study the encroachment of lodgepole pine upon ponderosa pine forests.

Munger started fieldwork upon this project immediately after arriving in Oregon, still working under Zon's direction from Washington, D.C. After 3 months in the field in the vicinity of Bend and Prineville, Munger went to Portland to prepare his report. From his field observations, he concluded that the encroachment of lodgepole pine was the result of repeated burning.[16] Completion of the report concluded this project. December 1, 1908, he was directed to report to the District Forester, District 6, in Portland where he was placed in charge of a newly formed one-man section of Silvics, working under Assistant District Forester Ames.

Soon after, in 1909, Munger started a study of growth and yield of Douglas-fir as a basis for management practices. Permanent sample plots were established on a number of the west-side National Forests. During part of the fieldwork on this project, Professor Frank S. Miller, the first dean of the College of Forestry at the University of Washington, worked with Munger.

At about the same time Munger joined the Forest Service, a number of other young forest school graduates also joined the Service as forest assistants; some of them were stationed at each of the six District Offices and some were attached to the Supervisors' offices on the National Forests. Many of these performed research studies as well as other activities. Some later followed research as a career; others remained in administration.

W. B. (Bush) Osborne and Julius F. Kummel came to District 6 in Portland about the same time as Munger. Edward J. Hanzlik reported to the Olympic National Forest in Washington State several years later. Each of these men made important contributions to the fund of forest knowledge in the Pacific Northwest, although never formally attached to the Research organization. Some of their contributions will be named later in this history at appropriate times.

Another landmark event that occurred in 1908 was the publication of "Trees of the Pacific Slope" by George B. Sudworth, Forest Service, U.S.D.A. Not only did this publication give meticulous information on the dendrological characteristics of all the Pacific Coast indigenous trees but it also gave an amazing amount of detail on the range and occurrence of each species. It provided basic information on tolerance, longevity, site and climatic preferences, and some information on seed and reproductive characteristics, physical properties of wood, uses, etc. This book is an important part of personal and institutional forest libraries throughout the West.

In November of 1909, Munger and "Bush" Osborne started a direct seedling study, using European species of oak and pine in the Mount Hood area. At that time Secretary of Agriculture Wilson, a renowned agriculturist, believed such seedling and planting studies were an important part of American forestry. Munger and Osborne, traveling by horse and buggy, were about to start work on the western lower slopes of Mount Hood when it started to snow. With several inches on the ground, discretion seemed to be in order. So scattering the seed on the top of the snow, they started for Portland to avoid being snowed in. Some years later, the appearance of these tree species among the native forest trees puzzled the unknowing.

16 Many years later, other studies made by R. F. Tarrant showed that soil and surface air temperatures were positive factors in lodgepole pine encroachment.

In addition to establishing permanent sample plots during this period, Munger, as well as others of the professional foresters in the District Office, made short-term empirical studies to answer some of the problems of the National Forest administrators. One of these made by Munger was a study of the encroachment of sand dunes on cranberry bogs, roads, and fields along the southern Oregon coast. Scotch broom, blackberry, and maritime pine were planted experimentally. The preservation of the sand dunes is now a matter of national interest. Scotch broom and evergreen blackberries are pests in many areas now and regularly eradicated along highway rights-of-way.

In 1911, the Office of Grazing Studies was established in the District Office with Charles E. Fleming in charge. Although grazing reconnaissance surveys were the principal activity, the field crews did make observations on growth and seeding habits of range plants, effects of different degrees of grazing by stock, wildlife aspects and watershed influences and values.

One of the obvious problems on the National Forests of the Pacific Northwest during this early period was the large area of nonrestocking burns. In 1910, a forest nursery was established on the Columbia National Forest in Wind River valley. This location was within the perimeter of a 604,000-acre burn which started in the Lewis River drainage September 8, 1902, and crossed the divide easterly into the Wind River drainage. During the fire,16 lives were lost. Commonly called the Yacolt Burn, it reburned in 1927 and 1929, denuding some areas which had restocked after the original fire.

After two seasons of operation, it was apparent that more solid information on nursery and planting techniques was needed if the project was to succeed. C. R. Tillotson of the Washington Office of the Forest Service was sent May 1912 to Wind River on a detail basis to initiate a study program. Tillotson returned to Washington in September of that year, and the program was turned over to the District Office to conduct in accordance with the developing program of decentralization of research recently initiated by Pinchot and Zon. C. P. Willis of the District Office was placed in charge of the infant program on a temporary basis.

The program outlined for the Wind River location consisted of: studies of improved nursery techniques, seeding and planting experimental tests on deforested areas to determine optimum methods and seasonality, and a Douglas-fir seed source study. In addition to this program, a miscellaneous collection of other studies were worked upon; namely, rodent study, examination of regeneration plots on cutover areas, seed storage tests, and the establishment of an arboretum.

The study programs outlined for the Wind River area were a direct reflection of the growing importance of timber sale activities on the National Forests of the Pacific Northwest and the realization of the urgent need for sound supporting data. Completion of the network of transcontinental railroads in the latter part of the 19th century, the expanding agricultural settlement of the West, and the rebuilding of San Francisco following the 1906 earthquake and fire hastened the growth of the Pacific Northwest timber industry. In 1905, Washington took the lead in the Nation's production of lumber, a position it was to hold for many years with the exception of 1909 when it was second. Although lumber production in the Pacific Northwest was centered near the navigable waterways and coastal harbors—Puget Sound, Columbia River, Willamette River, Grays Harbor, and Willapa Bay—the National Forests of the Cascade Range and Olympic Mountains were being considered as a source of stumpage for the increasing number of sawmills. Much of the privately owned timber, particularly the choice virgin stands in favorable and accessible logging locations, was concentrated in a comparatively few strong ownerships. As a matter of fact, the Federal Bureau of Corporations made a study of concentrated timber ownership in 1910, and the publication of the results must have called attention to the potential of the National Forests in the timber supply situation.[17]

Reconnaissance resource examinations of the National Forests were a primary order of business of the District Office of Silviculture immediately after it was established in 1908. Many of the young professional foresters

17 The Lumber Industry, U.S. Department of Commerce and Labor, Bureau of Corporations, Part F (Washington G.P.O. 1913).

attached to the Supervisors' and the Portland District Offices were engaged in making estimates of the volume and character of the old-growth stands as a basis for preparation of management working plans. As with the grazing survey crew, the foresters on the timber survey crews made observations on dendrological factors, site conditions, insect and disease problems, and other investigative matters.

Pinchot's Annual Report of 1909,[18] under the heading "Work for the Ensuing Year," enumerates types of studies needed in support of timber sale activities. These included studies on cutover lands to provide growth and yield data for second-growth stands; results from different methods of cutting upon streamflow; the "breeding of trees"; and the effect of seed source upon growth differences of the progeny. The same report mentions plans for establishing additional Forest Experiment Stations and concentrating forest products research in Madison, Wis. The plans for founding a forest products laboratory at the University of Wisconsin were given in detail. It was formally established in 1910 and McGarvey Cline[19] was named the first Director. Wood-testing work was continued at the University of California for a few more years and then phased out; however, other forest products studies were continued from the District Offices at Denver and San Francisco and the University of Washington for a longer period.

The year 1910 was notable in many respects with significant changes and developments. President Taft dismissed Gifford Pinchot as Chief Forester, a consequence of Pinchot's controversy with Secretary of the Interior Ballinger. He was succeeded by Henry S. Graves, which insured that objectives and policies of the Forest Service would be basically unchanged. This and the preceding year were severe fire years in the West. Light burning as a panacea was advocated by many people. Timber cut on the National Forests of California, Arizona, Colorado, Idaho, and Montana exceeded that of Washington and Oregon. Much of the demand in the leading States was for mine timbers and railroad construction. However, it was not long before timber cut in the Pacific Northwest began to surpass the other States.

A severe outbreak in 1910 of the mountain pine beetle in western yellow and lodgepole pine stands near Baker in eastern Oregon prompted the Wallowa Timber Co. to organize a control project. The Baker Forest Protective Association was formed to represent private timber owners, and with the Forest Service cooperating about 32,000 trees were felled and peeled with some burning over an area of some 100,000 acres. H. E. Burke of the Bureau of Entomology gave technical direction to this cooperative project. Following this project, Burke was sent to Placerville, Calif., to open a permanent field station called the Pacific Slope Station.

Timber owners in the Klamath Falls area became concerned about infestations of the western pine beetle in 1910 and 1911, and Jackson F. Kimball of the Klamath and Lake Counties Forest Fire Association convinced Dr. Hopkins to establish a field station of the Bureau of Entomology in that area. It was first located in Klamath Falls in 1911 but was moved to Ashland in 1912 and was under the direction of W. E. Edmonston, who had been working on the Baker control project. In 1913, J. M. Miller, formerly of the Forest Service but at that time in the Bureau of Entomology, moved to Ashland and commenced biological studies of cone and seed insects of western conifers. After graduation from the University of California, F. P. Keen joined this station in 1914 to work with Miller. During the war years, staff of the Ashland station was depleted and it was closed in 1925.

Two new Forest Experiment Stations were established in 1910, both in Colorado: the Fremont and the Wagon Wheel Gap. At the latter Station, streamflow studies were commenced using small paired watersheds. Work was also started at the Priest River Experiment Station in northern Idaho in 1910, but formal establishment did not take place until later.

18 Report of The Forester for 1909 by Gifford Pinchot. Forest Service, U.S. Department of Agriculture, G.P.O., Washington, D.C.

19 Cline was coauthor with J. B. Knapp of Forest Service Bulletin No. 88, "Properties and Uses of Douglas Fir," published in 1911, Washington, D.C.

The 1910 Annual Report[20] gives considerable space to eucalyptus culture in California and Florida and speaks of planting on the Angeles National Forest in southern California testing eucalyptus as a replacement for chaparral. Basket willow studies were still a prominent subject in the investigative program. Although Douglas-fir management got slightly less space than eucalyptus, the report did tell of important studies of growth and management of Douglas-fir in the Pacific Northwest. These studies conducted by Thornton T. Munger apparently were made independently of the earlier E. T. Allen red fir study. This work was published in 1911 as Forest Service Circular 125, "The Growth and Management of Douglas Fir in the Pacific Northwest," by Thornton T. Munger, Forest Assistant, Forest Service, U.S. Department of Agriculture, May 10, 1911. Largely descriptive, this report, covered the growth characteristics of Douglas-fir; soil, climate, density of stand, injury by fire, insects, and disease. It described reproductive characteristics and, based upon stem analyses and sample plot measurements, discussed growth rates, presenting supporting tabular data. Basing conclusions upon yield data and assumed financial aspects, Munger discussed costs and returns of second-growth management. General conclusions in the summary included three specifications for obtaining natural regeneration after cutting: (1) provision for seed trees, (2) slash burning, and (3) protection of the cutover land from subsequent fires.

Destructive avalanches during the winter of 1910 in the northern Cascades of Washington caused not only extensive property damage to dwellings, other buildings, and railroads, but also killed about 100 people in a stalled train. This directed attention to the role of forest cover in avalanche control. Munger made a study of this problem. His report, which was largely empirical in nature, was published in Forest Service Circular 173, "Avalanches and Forest Cover in the Northern Cascades," November 24, 1911. Munger drew upon personal observation and literature in Europe on this subject as well as field observations. He concluded that removal of forest cover on steep slopes by fire was a specific factor in this case.

Fire was a matter of growing concern to private timber-land owners and public forest-land managers. For the past few years, private owners had been organizing fire patrol associations in a number of localities in the Western States. With the leadership of George S. Long of the Weyerhaeuser Timber Co., the Western Forestry and Conservation Association was organized in 1909. E. T. Allen, who was the first District Forester, left the Service to become the first manager[21] of the new association. He was succeeded as District Forester by C. S. Chapman. Allen had long been a student of forest fires and their consequences, and this new organization provided the medium for mounting a continuing campaign to reduce the impact of fire upon forest management to a tolerable level. Allen was destined to be an influential factor in forest protection activities in the Western States and British Columbia for many years in his capacity as executive director of the Western Forestry and Conservation Association. District Forester C. S. Chapman left the Service in 1911 to take charge of Oregon Fire Protective Association; he was succeeded by George H. Cecil.

Another personnel change in 1911, which was to have a significant bearing upon Forest Service research, was the transfer of Earle H. Clapp, Associate District Forester in District 4, to the Washington Office as Chief Inspector Branch of Silviculture. Late in this year, the Priest River Experiment Station was formally established. This was followed in 1912 with the establishment of the Feather River Experiment Station on the Plumas National Forest in California, the Great Basin Experiment Station on the Manti National Forest in Utah, and the Cloquet Experiment Station in Cloquet, Minn. The latter was a cooperative arrangement with the University of Minnesota. The expansion of research in the Forest Service and the decentralization program drew attention to the need of a coordinating mechanism, and during 1912 and 1913 District investigative committees were organized with a central

20 Report of the Forester for 1910 by Henry S. Graves, Forest Service, U.S. Department of Agriculture, Washington, D.C.

21 Title of this position was later changed to "Forest Counsel." E. T. Allen was to hold this position until 1932 when he retired.

investigative committee in the Washington Office of the Forest Service to give in-house review and coordination of the expanding research activities. One of the first actions of the central committee was to define "investigative projects" and "administrative studies."[22]

On July 1, 1913, the Wind River Experiment Station was formally established and headquarters were located at the nursery site. J. V. Hofmann, who had transferred to District 6 in spring of 1913 to take charge of the study program at the nursery, was made Director of the new Station. The District Office of Silviculture had general supervision of the Wind River program as well as silvicultural studies at other localities in the District's area. Munger gave direct supervision to the silvicultural investigations Districtwide.

Soon after Hofmann took office, a new major study of the problem of natural reproduction of Douglas-fir was initiated; the first work was done on a part of the Yacolt Burn, which was not far from the Wind River headquarters.[23]

About the same time that the Wind River Station was established, the Converse Flat Station was established in southern California. Both of these Stations were formerly operated as nurseries.

The Central Investigative Report, Washington Office, made a significant policy recommendation to the Chief Forester in its 1914 report. It read "area of present forest experiment stations should be increased wherever practicable sufficiently to make them units of management thus giving the director of each experiment station: (1) An opportunity of trying out his experimental results on a practical scale under his direction; and (2) an opportunity of keeping in touch with the needs of forest administration by placing under his direction an area of sufficient size to involve most of the activities ordinarily found on National Forests." It was a number of years before this policy could be implemented in the field.

In other places, the Chief's annual report for example, a plan and policy of establishing additional Forest Experiment Stations in other parts of the country had been advocated. This was the period of expanding the National Forests to the Lake States, Eastern States, and Southern States under authority of the Weeks Law of 1911.

During this same period, the lumber industry was having economic difficulties prompting a special study by a number of Government agencies to determine causes and consider remedial actions. The study which was to be carried on for several years involved the Forest Service, other Department of Agriculture agencies, the Bureau of Foreign and Domestic Commerce, and the Federal Trade Commission. The Chief Forester, in reference to this study, pointed out that the heavy carrying charges of privately owned timber was resulting in a waste of a valuable natural resource.

The Fifth National Conservation Congress, convened in 1913 in Portland, Oreg., considered many problems of major importance to the Pacific Northwest, and several Pacific Northwest foresters and prominent citizens were active participants. Thornton Munger was a member of a subcommittee of the Forestry Committee on forest planting which reported on the conditions under which commercial planting is desirable. This committee was chaired by E. H. Clapp, Washington, D.C. Other members were S. N. Spring, vice chairman, Ithaca, N.Y., and S. D. Detwiler, Philadelphia, Pa. The problem of forest taxation was reported by the Taxation Committee of the Congress. Members were: E. T. Allen, chairman; Professor F. R. Fairchild, Yale University; E. M. Griffith, State Forester of Wisconsin; Dr. H. A. Drinker, President, Lehigh University; and Gifford Pinchot.

22 Report of the Central Investigative Committee to the Chief, Forest Service, 1913: "An investigative project is one which aims at the determination of a fundamental principle which is broadly applicable. If investigation seeks merely information on a specific case not involving a principle, it is considered administrative in character."

23 One of the field assistants employed on this study was Charles J. Kraebel, who later had a long and notable career in forest influences research at the Pacific Southwest Forest and Range Experiment Station in Berkeley, Calif.

In the Pacific Northwest, the investigative efforts of Forest Service professional foresters were strongly directed toward gathering information necessary to bolster the timber and range management programs of the National Forests. Forest assistants on each of the National Forests conducted studies, as did personnel in the District Offices of Silviculture, Products, and Grazing. Much of the timber management work on the forests was making volume tables and timber surveys. Although the studies were largely of the admin-istrative type, some contributed basic information on silvical characteristics of the indigenous forest species. In a number of instances, field personnel assisted in establishing and remeasuring permanent sample plots. For example, E. J. Hanzlik of the Olympic National Forest continued the work on growth and yield of Douglas-fir done by Munger and Miller in 1911. Hanzlik prepared a report in 1914 on "Growth and Yield of Douglas Fir on Various Site Qualities in Western Washington and Oregon." This report was never published in its entirety, but was reviewed by A. B. Recknagel in Forest Quarterly, vol. XII, No. 3, 1914, and included specific tabular data in a condensation of important findings.

Hanzlik also published in coauthorship with H. B. Oakleaf of the District Office, "Western Hemlock, Its Forest Characteristics, Properties, and Uses," in the October 1914 issue of The Timberman.

On June 1, 1915,[24] the Branch of Research was established in the Washington Office of the Forest Service under the direction of Earle H. Clapp as Assistant Chief. It was to be a number of years before this policy could be fully implemented at all levels of the Service and lines of authority and responsibility clearly defined and put into action.

Studies at Wind River progressed during 1915 and 1916 and had reached the stage of drawing conclusions and preparing reports. Hofmann reported on the study of Douglas-fir seed in cooperation with C. P. Willis in an article for the Proceedings of the Society of American Foresters, April 1915. Establishing test plantations on several of the District's National Forests of stock produced from the Douglas-fir study was a large undertaking for the small force at the Station.

In 1915, Munger was made Assistant Chief of the Portland Office, Division of Silviculture, under F. E. Ames and the Section of Silvics ceased to function as such. Munger's attention was directed to timber survey and timber sales. He continued to supervise administrative studies on the forests and he also found time to contribute to the enlarging body of forestry literature. For example, in 1915 he published a formula for normal growing stock in the selection system yellow pine forests. The February 1916 issue of Plant World included an article by Munger titled, "Parch Blight on Douglas-fir in the Pacific Northwest."

Foresters of this region had long made observations and studies of forest disease and insect problems, but no scientific studies were made until 1910 when Dr. E. P. Meinecke, a trained pathologist of the San Francisco office of the Bureau of Plant Industry, initiated a study of decay in white fir, *Abies concolor,* on the Crater National Forest in southern Oregon. In 1912, Munger worked with Meinecke on this study. Owing to the high incidence of decay in white fir which occurred in southern Oregon in mixture with the more valuable western yellow pine, *Pinus ponderosa,* problems were encountered in managing these stands. It was customary timber-cruising practice to cull white fir trees if conks (fruiting bodies) were detected on the lower trunk.

One of the difficulties of establishing sustained yield practices on the National Forests of the Pacific Coast States was the relatively large acreage of mature and overmature stands. Little was known of the rate of growth, progress of decay, and endemic mortality loss from all causes. Many of these forests contained varying quantities of so-called inferior species. These species were in disfavor with timber purchasers, a result of marketing problems. White fir was one of these species owing to its physical and mechanical properties; its wood was brittle, did

24 Graves, in his annual report for 1915, stated that" lines of investigation were brought under one direction by establishment of the Branch of Research. During the previous three years the various studies and investigations were correlated by means of investigative committees but the establishment of a separate branch was deemed advisable to make such correlations more complete and at the same time to segregate investigative work from administrative work in accordance with the policy of the Department." "It was further the purpose of this change to give research work and personnel fullest recognition and to develop and strengthen their research as a coordinate division of the Service."

not season well, and had a sour smell when green. The latter property resulted in this species being called by a vulgar and derogatory name. Douglas-fir, yellow pine, and sugar pine were favored in the construction industry, and the pines were prized for box shook. White fir was a common component in the yellow pine forests of southern Oregon and California. This complicated preparation of working plans and regulation of the cut. If the white fir was left after the first cut, it could alter the composition of future stands since it was aggressive and highly tolerant. Meinecke determined that a heart rot, *Echinodentium tinctorium,* was responsible for most of the loss by decay in white fir, and after about 130 to 150 years of age, decay was excessive. Results of his study were published in "Forest Pathology in Forest Regulation," U.S. Department of Agriculture Bulletin 275, Professional Papers, a contribution from the Bureau of Plant Industry, April 1916.

Similar situations existed in other major forest types of the Pacific Northwest. This illustrated the size and scope of the job facing the small research force and the difficulty of maintaining a balanced program aimed at long-range solutions.

Also in 1916, a report on Munger's study of western yellow pine on methods of cutting, growth and yield, and other management considerations was sent to the Government Printing Office. Fieldwork on this project had been carried on since 1912 when the first sample plots were established. T. J. Starker and Professor Hugo Winkenwerder assisted Munger on the early work on this project.[25]

In 1916, Dr. J. S. Boyce, an assistant of Dr. Meinecke in the San Francisco office of the Bureau of Plant Industry, initiated a study of diseases of Douglas-fir at Oakridge on the Willamette National Forest. Decay in mature Douglas-fir, particularly in the southern Cascades, was an important problem in management and utilization of this important species.

The District 6 Investigative Committee was getting into full swing by 1916, and for the first time, forest supervisors were included in the membership. The report of the meeting held January 9, 1917, listed the following members: Chiefs of the District Offices of Grazing, Products, Operation, Forest Investigations (formerly Silvics); F. H. Brundage and Homer Ross, both Supervisors; J. V. Hofmann for the Wind River station; and Julius Kummel representing planting. Munger was secretary and evidently was acting for the Division of Silviculture as well as over-all representative of research. There is little doubt that he was a prime mover in the meetings and a leader in organizing the committee and formulating procedures and policies.

During 1916 and 1917, work of the previous several years at Wind River resulted in a number of publications reporting findings of Douglas-fir studies; chiefly by J. V. Hofmann, although C. P. Willis and C. J. Kraebel also participated in the publications which appeared in professional and technical journals. Although Douglas-fir was the major species in seed studies, minor studies of the same nature were conducted on other west-side species and on western yellow pine. Work on Douglas-fir seed, although modest compared with present circumstances, was a major pioneer effort in forest genetics at that time and was a foundation for an expanding program in years to come. The other ranking studies at Wind River during this time were also concerned chiefly with Douglas-fir; those of nursery and planting (techniques) and regeneration.

District 6 professional personnel were giving considerable attention to preparation of volume tables and there was a proliferation of local tables. This caused concern on the part of some, and considerable discussion apparently was taking place. At the meeting of a Forest Investigative Conference held in Washington, February 26-March 3, 1917, attended by Munger and Hofmann, this was one item on the agenda. Munger presented a paper titled, "The Most Vital Problem in Forest Investigations Is How Far Research Should Go in Preparation of Volume Tables." Unfortunately, a copy of the paper or record of the discussion following it could not be located.

25 T. J. Starker was a prominent member of the faculty of the School of Forestry, Oregon Agricultural College, and is still active as the owner and operator of tree farms in western Oregon. Hugo Winkenwerder became Dean of the College of Forestry, University of Washington in 1912, a position he held for 33 years.

Products research since its early inception was continued from the District 6 office and at the University of Washington. As in the silviculture study program, Douglas-fir was the major object of the work. For example, by January 1, 1917, over a 9-year period, nine mill-scale studies had been made, most of which were of Douglas-fir, although studies were also made of western yellow pine and Sitka spruce (the latter study was made in Alaska, which at that time was a part of District 6). Other regional studies in products consisted in lumbering methods and costs done by H. B. Oakleaf, marketing studies, statistical surveys of lumber prices and production, and continuing work on mechanical and physical properties of the wood of western softwood species.

Range studies were also conducted through the District Office and on the pertinent National Forests under the direction of Jessie L. Peterson, who succeeded Fleming in charge of the District Office of Grazing Studies in 1913 when Fleming was transferred to another District. The studies included artificial reseeding, utilization of brush by grazing by goats[26] and carrying capacity of various vegetative types suitable for grazing. In 1916, Jardine obtained funds for grazing assistants on National Forests to help the Supervisors apply range management plans and to make local empirical studies. In District 6 this group included Walter Dutton, John Kuhns, F. V. Horton, and Douglass C. Ingram. However, no systematic program of scientific range research based upon the early work of Sampson and Jardine was in motion at this time.

The entrance of the United States into World War I severely curtailed research work in the Forest Service in 1917 and the 2 years following. Many Forest Service personnel from the Chief Forester down joined the armed forces. Others were involved in a civilian capacity with defense and war programs. The 10th and 20th Engineer Regiments which both served in France were staffed to a great extent by Forest Service personnel. Chief Henry S. Graves and Associate Chief William B. Greeley were ranking officers in these units.

The Wind River station lost Kraebel, Brown, and Augspurger,[27] a field assistant, to the military, leaving Hofmann alone to carry on the research program. F. E. Ames, Assistant District Forester in charge of the Division of Silviculture, was commissioned in the Engineers and Munger was placed in charge in his absence. This move virtually restricted Munger's activities to administrative duties. J. F. Kummel took Munger's place in charge of the Silvics Section of District 6 during this period.

The Products office in District 6 was completely vacated by military leaves, transfers, and resignations, bringing work there to a standstill in 1917 and 1918. The wood-testing laboratory at the University of Washington was also shut down during 1917 and did not reopen until after the war.

A major war effort of the District Office of Silviculture under Munger was to assist in the production of Sitka spruce lumber for aeroplane manufacture. The Army Engineer's Signal Corps was operating a remanufacturing plant at Vancouver, Wash., to produce the spruce aeroplane stock. Other foresters were serving in this military unit, including Leo A. Isaac who later joined the Station's staff.

During 1919, work at Wind River was strengthened by the return of Kraebel and Brown from the military and the employment of several field assistants.[28] This enabled a pickup in the Douglas-fir natural reproduction studies and nursery and planting studies. In addition, a beginning was made upon thinning studies, testing several degrees of spacing in the Wind River plantations.

During the war years, Hofmann, a prolific writer, continued to publish reports on the progress of past and current work at Wind River.

26 In 1917, W. R. Chapline made a study of the Angora goat industry in western Oregon as a World War I emergency project.

27 Stanley Augspurger was an early casualty of the war, losing his life with the sinking of the Tuscania late in 1917.

28 One of these field assistants was H. T. Gisborne, later a prominent member of the staff of the Northern Rocky Mountain Forest and Range Experiment Station specializing in fire research.

In December of 1919, the Wind River Experiment Station was transferred from the control of the District Office to that of the Washington Office, thus establishing the independence of that segment of the research program from National Forest administration.

The year 1920 marked the beginning of a decade of great importance to the Forest Service nationally and regionally. In particular, this decade included legislation of special significance to the Branch of Forest Research. During the 1920's, the Forest Service position as the leader in forest research nationally was established firmly. The Bureau of Plant Industry opened a regional Office of Forest Pathology in Portland March 1, 1920, and Dr. John S. Boyce was transferred from the San Francisco office to take charge. This strengthened the study of heart rots in Douglas-fir stands which he had initiated earlier working out of San Francisco. Soon after, white pine blister rust was detected on the alternate host, *Ribes nigrum,* at Vancouver, British Columbia, late in 1920. This apparently was introduced on white pine imported from France in 1910 and planted in a nursery in British Columbia. This was the cause of great concern to foresters, since blister rust had invaded the eastern white pine forests and there was fear it would eventually spread overland to the West. In 1922, Harry G. Lachmund, also from San Francisco, was transferred to Portland to assist Dr. Boyce and to take charge of a blister rust control program.

In January of 1920, the "Olympic blowdown," as it was known, made history for the intensity of the windstorm and the volume of timber destroyed, which was estimated at 6 billion board feet. Owing to the relatively uninhabited condition of this area, little property damage other than loss of timber resulted. However, the vast tangle of down timber was a great fire hazard. Dr. Boyce commenced a study of the deterioration by decay of windthrown timber on the Olympic Peninsula resulting from the 1921 storm a few years after it occurred.[29]

Henry S. Graves returned to his position as Chief Forester in 1918, relieving Albert F. Potter who was Acting Chief while Graves was on military leave. However, at the end of 1919, Graves resigned to return to Yale University as Dean of the Forest School. He was replaced by William B. Greeley. Although the broad policies and objectives of the Forest Service remained generally the same after the transfer of leadership, there were differences between Chief Forester Greeley and previous administrations in the methods used to achieve goals. For several years, legislation regulating forest practices on private forest lands had been debated in Congress. Senator Arthur Capper of Kansas, a long-time advocate of forest conservation, was leading the move to this end and introduced legislation to accomplish it. In the House, Congressman Bertrand Snell of New York, although advocating regulation of private cutting, was disposed to compromise and achieve the objective by establishing a cooperative relationship between Government and industry.

Forest Service leaders in Washington and doubtless in the field, too, were divided on the question of forest regulation of private cutting practices. Graves and Clapp favored legislation as proposed by Senator Capper. Although no longer in the Forest Service, Gifford Pinchot supported these views vigorously. Greeley, on the other hand, believed that the goal of advancing progressive forest management on private lands could best be achieved by legislation establishing a cooperative approach with the States and the timber industry. Unlike Graves, Clapp, and Pinchot, Greeley, although New England born, was graduated from the University of California[30] before studying forestry at Yale University and had an extensive background of field experience and knowledge of forest problems of public and private forests in the West. Moreover, he understood the attitudes and thinking of the leaders in Government and business in the timber States of the West, which assisted him in developing policies and programs which had their acceptance.

29 Results of this study were published in 'Deterioration of Wind-Thrown Timber on the Olympic Peninsula, U.S.D.A. Technical Bulletin 104, 28 pages, contribution of Bureau of Plant Industry, 1929, by Dr. John S. Boyce.

30 Greeley was awarded a Bachelor of Letters degree with honors in 1901. President Benjamin Ide Wheeler of the University, anxious to start a forest school at his institution, offered Greeley a chair in Forestry in 1909 which he refused.

Greeley was also impressed by the success of the cooperative fire protection work of the several associations led by E. T. Allen, C. S. Chapman, and others. They were demonstrating advantages of developing programs of fire prevention and control with the Western States.

The Capper-Snell proposed legislation reached a stalemate in Congress. The forest industries led by Royal S. Kellogg and E. T. Allen had organized effective opposition to these bills. However, Senator Capper introduced a Senate Resolution calling the Secretary of Agriculture to report on or before June 21, 1920, on timber depletion, lumber prices, lumber exports, and concentration of timber ownership. This was enacted on February 21, 1920. The report prepared by the Forest Service was principally the work of Assistant Forester Earle H. Clapp, in charge of the Branch of Research. It was transmitted on June 1, 1920, by Chief Forester Greeley to E. T. Meredith, Secretary of Agriculture. Although this report did not have the advantage of soundly based, detailed data on the nature and extent of the Nation's forest resources, it did represent the beginning of a series of periodic reports on the status and problems of the forest resources and their role in the Nation's social and economic welfare. Chief Forester Greeley in his letter of transmittal pointed out that to obtain truly authoritative basic data would require "an exhaustive field study covering at least two years." In retrospect, this would seem to be a modest estimate of the magnitude of such a study.

Despite this acknowledge shortcoming, the report was not a hastily done study. Beginning about 1910, Forest Service and other Federal agencies had a continuing program of accumulating the information used. There is little doubt that the Forest Service anticipated the Capper resolution and was preparing for this opportunity. The findings of this program were adequate to develop broad conclusions and to suggest legislative action to correct some very evident problems in the exploitation and utilization of the Nation's forests. In some respects, one of the most important conclusions was the outline of a National Forest research program to provide the necessary tools for bettering the management of public and private forest lands. Specifically, the Capper Report under "Federal Legislation Needed" recommended "The survey and classification of forest resources," and under "Current Appropriations for Forest Research" stated that, "The current appropriations of the Forest Service should be sufficient to maintain experiment stations in all the principal forested regions of the United States."

The report went on to recommend that appropriations, which had been cut and resulted in closing four of the Experiment Stations, should not only be restored but increased to expand the program to all forest regions.

Although events of 1920 had considerable significance to forest research generally, the Wind River program was hampered by a reduction of funds and midyear loss of Kraebel through resignation. Work at Wind River during 1921 and 1922 continued at a slow pace with Hofmann the only professional employee at the Station. He continued to turn out a number of articles for various professional journals and trade journals, chiefly on Douglas-fir regeneration, in spite of the burden of maintaining measurements and records of on going research installations. In spite of the shortage of help, Hofmann commenced a new study in 1922; that of fire weather. The District Office furnished the funds to install a complete meteorological station at Wind River. W. B. Osborne[31] on the District Office staff was interested in this field of inquiry also and contributed much to the progress of this project. In 1923, A. Gail Simson was added to the Wind River staff to work exclusively on fire weather studies. Several publications on various aspects of the fire weather studies were prepared by Hofmann in 1923. One joint publication by Hofmann and Osborne[32] concluded that relative humidity was a critical factor in fire prevention and control.

In April 1924, J. V. Hofmann resigned as Director of the Wind River Station, and Leo A. Isaac, forest assistant on the Chelan National Forest, was transferred to the Station to take charge of the work program until a successor was appointed to the directorship.

31 In 1919, Osborne prepared several chapters in the "Western Fire Fighters Manual," a classic of its kind which was issued by the Western Forest and Conservation Association. He also invented and developed the "Osborne Fire Finder," an invaluable instrument for use of lookouts in pinpointing location of fires.

32 "Relative Humidity and Forest Fires," by J. V. Hofmann and W. B. Osborne, Proceedings Forest Management Conference, Lumber World Review, Dec. 25, 1925.

CHAPTER III. THE PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Its Establishment and Growth, 1924—1939

The fiscal year 1925 Federal Appropriation Act increased funds for silvical investigation, and $26,000 was allotted to establish the Pacific Northwest Forest Experiment Station to serve this region. On July 1, 1924, Thornton T. Munger was named Director. This was the fifth such Station established, the preceding four being the Appalachian, Asheville, N.C.; the Southern at New Orleans, La.; the Northeastern at Amherst, Mass.; and the Lake States at St. Paul, Minn. These five Stations were placed directly under the supervision of Assistant Forester Clapp in the Branch of Research.

For several years prior to 1924, Pacific Northwest foresters had wondered at the expansion of forest research in the Eastern and Southern States in contrast to the inadequately financed program here. Some ascribed it to political clout; others to aggressive support for research by southern and eastern timber industries in contrast to the western timber industry.

The Wind River work program and pertinent structures and installations were transferred to the newly created Station and Wind River was designated as a fieldwork center. The permanent personnel at that location, Leo A. Isaac and A. Gail Simson, were transferred to the new organization. Richard E. McArdle was appointed as a Junior Forester July 1, 1924 from the Civil Service eligible list. June H. Wertz was transferred from the District Office to the position of clerk of the fledgling organization, two very fortunate selections as events later proved. The additional funding permitted the hiring of four field assistants, a diverse group from the standpoint of future careers. The four were Leonard I. Barrett, later a Director of two Forest Service Experiment Stations and a Washington Office research division chief; John McGinn, who became a successful lumber merchandiser; Robert Marshall, who in later years was a leading and eloquent advocate of forest wilderness areas and a well-known writer; and Edwin L. Mowat, a diligent and meticulous researcher who completed a career in ponderosa pine silviculture at this Station.

Assistant Forester Clapp came West to discuss organization and program matters with Director Munger. Together they spent 2 weeks traveling over the region and viewing possible headquarters locations. The decision was to locate in Portland, and offices were rented in the Lewis Building at Fourth and Oak Streets, which was out of the “high rent” district but conveniently located with respect to the District Office and downtown business amenities and transportation facilities. In addition, it was only two blocks from the Central Police Station, an unnecessary advantage since night workers at the office, not at all uncommon in those days, could feel safe at any hour on Portland streets at that time.

McArdle’s first assignment was to initiate a study of growth and yield in even-aged stands of pure Douglas-fir. Isaac continued the Douglas-fir regeneration studies, establishing a permanent transect 2 1/2 miles long and 6.6 feet wide across recently cutover lands on the Columbia National Forest (later renamed the Gifford Pinchot National Forest).

Initially, Alaska and southern Idaho were included in the Station’s territory, but District 4, which administered the National Forests in that portion of Idaho, opposed the extension of the Pacific Northwest fieldwork to that area, looking to the prospect of obtaining the establishment of a regional Forest Experiment Station in their territory. Owing to lack of funds, little or no research was being done in Alaska at that time.

The meeting of the District 6 Regional Investigative Committee, held February 3, 4, and 5, 1925, covered many important questions of policy and procedure. The committee was chaired by C. M. Granger who succeeded George H. Cecil as District Forester January 1, 1925. In addition to the Forest Service members, other agencies

were represented, although not official members of the committee. These included Dr. Boyce for forest pathology, A. J. Jaenecke for forest entomology, and Meteorologist Weels of the Portland Weather Bureau office. District Forester Flory of District 8, Alaska,[1] attended, and District 4 was invited but did not send a representative owing to a conflicting meeting. State Foresters Elliott of Oregon and Pope of Washington attended as did Professors Peavy, Winkenwerder, and Steffen from the forest school faculties of Oregon Agricultural College, University of Washington, and Washington State College, respectively. E. T. Allen, for the Western Forestry and Conservation Association, R. B. Allen, A. W. Cooper, and David T. Mason were also invited to offer program suggestions for consideration. E. T. Allen, Hugo Winkenwerder, and George Peavy were invited to attend the sessions. Norman G. Jacobsen, a former District 6 employee and then E. T. Allen's assistant in the Association, attended the sessions. Although the record did not name Peavy and Winkenwerder as attendants, there is evidence to believe they were present.

In view of Clapp's policy of concentrating on major problems and not dispersing research efforts over "quickie" projects, the committee agreed to plan a 5-year program. A subcommittee was appointed to recommend assignments to the major projects and a program of subtopics for the technical assistants on the National Forests of the District. Approved administrative studies were kept to a minimum. For example, practically all grazing studies were discontinued and field efforts were chiefly concentrated on one major project, "Grazing Management of Cut-Over Areas." Douglas C. Ingram of the District Office of Grazing was the leader of this study. E. J. Hanzlik of the District 6 Office of Forest Investigations and Experiment Station personnel cooperated on forest tree phases of the project.

This was a postwar boom period and the Pacific Coast States were growing rapidly in population. Many of the new residents were looking for cheap farmland and much of the logged-over lands in the Douglas-fir region was of gentle topography suitable for tillage with a temperate climate. There were both small- and large-scale attempts to convert this land to agriculture. "Stump" ranches were a common sight upon traveling the backroads, and the neighboring logging camps and sawmills offered part-time employment while the land-clearing process, many times by axe, grubhoe, and match, continued. In other instances, reseeding of cutover lands for grazing of beef and dairy cattle and sheep amid the stumps was a larger undertaking. Some of the agronomists and other college and extension agriculturists were encouraging this development with technical advice. "Cut out and get out" was still the philosophy of some timber owners who, with their experiences in the Eastern and Southern States fresh in their minds, were thinking of timber in terms of a single crop. As a result, such timber owners had organized programs of selling cutover lands, but others (probably a minority) were attempting to separate the truly agricultural lands from timberland and dispose of the former. The basic economic factors were also reflected in the new emphasis in the forest products study program adopted in 1925. Work in this field was still divided between the District Office and the Seattle Laboratory at the University of Washington, and much of it was of routine-nature, survey-type studies such as the lumber and related product census; collection of stumpage, round wood, and manufactured wood product price data; other so-called economic studies; seasoning studies; utilization of regional hardwood species from the Portland Products Office; and mechanical wood properties tests at Seattle Laboratory, which was restaffed with two men, Zimmerman and Stinson, after World War I.

With Clapp's precepts of concentrating on major problems in mind, the products program for 1925 was directed to "waste" utilization studies as an overriding objective with all available resources employed on such studies. This was divided into two phases, woods "waste," and manufacturing "waste" or "millwaste." A first step was to conduct surveys to determine the volume, nature, and source of the unused material. The obvious next step would be to study ways of eliminating poor practices and to find uses for the residues. The Portland Office under W. H. Gibbons, who had succeeded H. B. Oakleaf in 1920, was assigned the woods "waste" study which, in addition to the basic survey, was to include a felling and bucking study. The latter was to be a joint project with the District Offices of Products, Forest Management, and National Forest field personnel participating. The manufacturing

1 Alaska was no longer a part of District 6 at this time, having been made a separate district several years earlier.

“waste” phase was to be conducted by the Seattle Laboratory, although there were some personnel problems there as Zimmerman was resigning. There was also discussion at the 1925 committee meeting of transfer of mechanical wood-testing work to the Madison Laboratory.

Underlying all this discussion was the premise that “cheap” stumpage was the cause of poor utilization of wood and a major deterrent to the timber industry “practicing forestry” in the Douglas-fir region. This was fostered by the thinking that the industry saw no end to the visible supply of inexpensive raw material. In the background was the National Forest timber as a windfall source of cheap stumpage.

As a part of the “wood waste” project, a study of commercial utilization of western hemlock was proposed by the District Office of Forest Management (formerly called Office of Silviculture). Apparently, the Forest Service standards of utilization for western hemlock in timber sales were not in accord with commercial practice, and administrative problems were occurring.

It was difficult to market hemlock lumber for most uses in California and eastern markets at that time. This was partly due to the association of the name with eastern hemlock (an entirely different species), which had been in disfavor in the construction industry for years. At this time, lumber production in the Douglas-fir region was reaching new highs. There was an excess of mill capacity. Production was outrunning demand and prices were marginal for many companies in spite of the cheap stumpage. The cargo mills on Grays Harbor, other coastal harbors, the Puget Sound, and Columbia River were shipping large quantities of construction lumber to California and the Atlantic Coast. Since weight was not a factor in water shipping costs, much of the lower grades went green or partly seasoned to market, particularly to southern California which was experiencing postwar population growth and a building boom.

New oil fields were opening up in that area and at that time oil derricks were constructed of wood. The expanding movie industry established in Hollywood and nearby towns was becoming not only a major source of income but also a tourist attraction for southern California. The citrus and other fruit and vegetable crops were bringing more money and people not only to this part of the State, but also to the rich central valleys further north. All these factors combined to increase housing starts greatly. Owing to the climate and proximity to timber country, wood was a favored house construction material. However, western hemlock could not compete with Douglas-fir (or Oregon pine as it was known before the Federal Trade Commission frowned) except on a price differential basis. Part of this was the result of prejudice on the part of the builders, particularly those from the Eastern States, and partly to the inferiority of green or partly seasoned hemlock to Douglas-fir for house framing. Waste owing to shrinkage problems and nailing difficulties were cited by construction workers to discourage its use by contractors, architects, or home owners.

Wood containers were in general use to ship fruit and vegetable crops from farm to market. Box shook was a major item in the Pacific Coast western pine lumber industry. However, western yellow pine and sugar pine were the favored species and most pine mills of California, Oregon, and Washington sent the lower grades of common boards to their box factories. Again, western hemlock was at a disadvantage in this market because of its nailing properties and weight compared with the softer and lighter pines. Although a nailing machine had been invented, it was not in general use and by far the largest part of the shook made into boxes and crates was done by hand. A great deal of the hand nailing was done by piecework and the professional nailers fought the substitution of cheaper hemlock shook by the growers and shippers.

Western hemlock and Sitka spruce were at a slightly better position in the industrial shook market. The big item in this market provided by the California oil refineries was the “two five” oil case. These were used to ship kerosene and gasoline in two 5-gallon cans to domestic and export markets. The Orient, China in particular, was a major market, and in this situation weight of the container was not a significant cost factor. It was commonly said that the Chinese used the wooden containers to construct huts for the poor and the empty cans were flattened for roofing.

The paper and pulp industry was on a comparatively small scale at this time. Later, this industry, particularly the sulphite mills, provided a major market for hemlock and spruce logs. It is interesting to note, however, that early in 1925, M. A. Wortheimer of the Tilmony Pulp and Paper Co.[2] of Wisconsin was on the Pacific Coast investigating availability of wood waste as a source of raw material for establishing a sulphate pulpmill.

Considering all these factors and general economic conditions, it is evident that price instability and weak markets for western hemlock were a major problem to forest managers and the timber industries of the Douglas-fir region.

Landmark forest legislation in 1924 was the passage by Congress of the Clarke-McNary Act on June 7. When the Capper and Snell bills reached a legislative stalemate in 1923, Senator Charles L. McNary, who had been elected to the Senate from Oregon in 1918, introduced a resolution in the Senate calling for appointment of a Select Committee on Reforestation charged with investigating the forest situation with the objective of developing a sound forest policy to "insure a perpetual supply of timber for the United States." During the hearings on the Capper and Snell bills, it was evident that conclusive information had not been presented to obtain a consensus of Congress. The Committee held a series of hearings throughout the country and armed with facts and opinions from the "grass roots" reported to Congress in January 1924. Senator McNary, a native Oregonian, was thoroughly familiar with forest and agricultural problems in the West and at a comparatively early political age was an astute politician. The thrust of the Clarke-McNary Act was cooperative fire protection and planting assistance to private forest-land owners through the several States. The Act had other features; for example, it brought farm forestry into the national program. Of special interest to research, however, was the discretionary authority given in Section 3 to the Secretary of Agriculture to use funds appropriated under this Act to "study effects of tax laws, methods and practices upon forest perpetuation and to cooperate with appropriate officials of the various States or other suitable agencies in such investigations and in devising tax laws designed to encourage the conservation and growing of timber and to investigate and promote practical methods of insuring standing timber on growing forests from losses by fire." This special legislative provision for forest economic research was a herald of future research-directed legislation.

E. T. Allen had a principal part in the drafting and passage of the Clarke-McNary Act. It was in accord with his long-held views. Chief Forester Greeley, who had the faculty of approaching a problem directly, and incisively, believed more forestry progress could be obtained through cooperation with the States and the timber industry than through a Utopian goal of Federal regulation and large-scale acquisition of private timberlands. This legislation did much to gain the timber industry support of Forest Service activities, a retreat from the vigorous and critical opposition to the Capper bill and similar legislative approaches.

The program outlined for the Station in 1924 gathered momentum during 1925 and 1926 and despite little or no increase in appropriated funds, a number of field assistants were employed, nearly all assigned to the Douglas-fir growth and yield study. Isaac and Simson continued to work out of Wind River (then called a branch station) during the field season. Isaac expanded the spacing test series of Douglas-fir on logged-over and burned lands. He also started work on seed storage and germination on the forest floor in virgin Douglas-fir stands. Later in the year, he installed a seed dispersal study from an isolated patch of Douglas-fir, spacing a series of rodent-proof seed traps for a quarter of a mile distance from the seed source.

July 1, 1925, R. H. Westveld was appointed to the Station from the junior forester rolls and was assigned to a study of slash disposal in the yellow pine region of Oregon and Washington, strengthening the research program in this important part of the Station's territory and giving better balance to its program generally.

2 Report of the District 6 Investigative Committee for 1924 issued March 5, 1925. M. A. Wortheimer later founded the Longview Fibre Co. at Longview, Wash., using mill residues from the Long Bell Lbr. Co. as a source of raw material.

Formation of an advisory council had been planned as an integral part of the Station's organization from the time of its establishment in 1924. However, selection of suitable and willing members and submission of the list to the Secretary of Agriculture for approval and formal appointment was not completed until December of 1925. This delayed activation of the council until February 1926 when the first meeting was held in Portland. C. S. Chapman, then chief forester for the Weyerhaeuser Timber Co., was elected chairman of the council of 19 members, and T. T. Munger served as Secretary.[3]

At its first meeting on February 13, the Council reviewed the program which was essentially the same as that presented and approved by the Regional Investigative Committee at its 1925 meeting. The Advisory Council made several suggestions and recommendations which were discussed and concurred in by the Regional Investigative Committee at its 1926 meeting of February 15 and 16.

The details of the Council actions at this time were not as important as the more general considerations. The composition of the Council was highly significant as was their active participation in developing and reviewing the Station's programs and policies. Establishment of this precedent at the outset in the Station's organization and growth was a positive factor in maintaining program balance and orientation, in giving currency to the Station's findings, and in gaining support for the Station generally. The Council roster included public and private professional foresters, forest school educators, State foresters, and timberland owners and managers. Each of these men was a leader in his field. The group was mainly associated with forest protection and timber management and utilization with only one person, Dean E. C. Johnson, directly representing range and watershed interests. However, this was only a reflection of the times and the committee composition changed as uses of the forest other than timber production became better known and appreciated in later years.

The close ties between the Station and the regional forest schools fostered the introduction of recent forest research results into the curricula of these institutions. On several occasions, Station personnel delivered lectures and led seminars at the schools. Faculty members often had some personal research projects. The schools had access to scientific laboratories which the Station lacked. In later years, this program of cooperation and reciprocity strengthened graduate study programs, faculty research, and the Station's total activities. In a similar fashion, the Station's advisory policy was to prove to be a factor in advancing public and private forest management practices as the years went by.

Early in 1926, Isaac made an ingenious test of Douglas-fir and western hemlock seed flight by releasing the seed from a box kite flying at approximately tree height, 175 feet, from the ground. This was done at a snow-covered airfield in Vancouver, Wash. Isaac, a careful observer of natural phenomena, had a faculty for using simple and practical methods to solve silvicultural problems. His long and notable career in Douglas-fir silviculture profited by his ingenuity and perceptiveness.

With the basic field work completed on the Douglas-fir growth and yield study and computation of the data collected during the two previous field seasons well underway, McArdle was available to take on a new assignment in 1926. He assumed leadership of the fire studies which were in need of reorientation and

3 In addition to C. S. Chapman, the committee members were: E. T. Allen, Western Forestry and Conservation Association, Portland, Oreg.; J. L. Alexander, Forest Branch, British Columbia, Victoria, B.C.; E. S. Collins, Ostrander Railway and Timber Co., Portland, Oreg.; A. W. Cooper, Western Pine Manufacturers Association, Portland, Oreg.; A. C. Dixon, Booth Kelly Lumber Co., Eugene, Oreg.; F. A. Elliott, State Forester, Salem, Oreg.; C. M. Granger, District Forester, U.S. Forest Service, Portland, Oreg.; Russell Hawkins, The Whitney Co., Garibaldi, Oreg.; E. C. Johnson, Dean of Agriculture, State College of Agriculture, Pullman, Wash.; George C. Joy, State Supervisor of Forests, Olympia, Wash.; Frank H. Lamb, Hoquiam, Wash.; D. T. Mason, Mason and Stevens, Portland, Oreg.; B. T. McBain, Portland, Oreg.; R. D. Moore, Shevlin-Hixon Lumber Co., Bend, Oreg.; C. W. Peavy, Dean, School of Forestry, Oregon Agricultural College, Corvallis, Oreg.; R. W. Vinnedge, North Bend Timber Co., north Bend, Wash.; and Hugo Winkenwerder, Dean, College of Forestry, University of Washington, Seattle, Wash.

consolidation of objectives. The transfer of Walter H. Meyer, assistant silviculturist from the Northeastern Station and a well-trained mensurationist, added a new dimension to Station research. He was placed in charge of all mensuration studies, commencing work on the application of normal yield tables to average stands of Douglas-fir.

The logging waste study under the direction of A. H. Hodgson of the District Office of Products was off to a good start during 1926. Careful advance planning by Hodgson resulted in rapid approval of the working plan by the District Forester and Washington Office. Hodgson, after reviewing all available pertinent literature, visited a number of industry manufacturing plants and logging operations to study manufacturing and logging practices and to arrange cooperation. He had the help of Forest Service check scaler George Stevenson in the field in setting up specifications for grading and measuring sound material and for making allowances for decay and other defects. The ready cooperation of participating companies was no doubt partially the result of the Advisory Council policy, since this study, although not directly under the Station, was closely related at that time and had been discussed at the meeting. This study and the slash disposal studies underway were the forerunners of the continuing efforts to reduce the volume of forest residues, which has formed a large part of the research directed to abatement of the fire hazard and to the enlargement of the usable timber resource.

Results of the red alder study, underway for several years, were published in 1926 as Departmental Bulletin No. 1437, “Red Alder of the Pacific Northwest,” by Herman M. Johnson of the District Office of Products. Pacific Northwest hardwoods and their industrial potential received considerable attention from the Products group. Studies had been made of several other species, but owing to its abundance and relatively rapid growth, red alder, *Alnus rubra,* received primary attention with bigleaf maple, *Acer macrophyllum,* following in a few years. The obvious possibility was manufacture of furniture, and there was a small industry underway at that time. However, for many years to come, fuelwood was the principal use of these broadleaf species.

A notable historical event took place in 1926 when 280 acres of virgin Douglas-fir on the Columbia National Forest, a short distance from the Wind River field station, was set aside as a “natural area” by District Forester Granger. By his orders it was to be maintained permanently in pristine condition for scientific ecological studies. This was not a sudden decision but was the culmination of years of discussion and effort, chiefly by Munger, to accomplish it as a firm policy. The movement started in 1917, when Professor V. E. Shelfer of the University of Illinois in Urbana, as a representative of the Ecological Society of America, asked Munger to serve as a member from Oregon of the Natural Area Committee of the Society. At the time, Professor Shelfer was compiling a list of natural areas nationwide. Munger proposed a natural area for Douglas-fir in the Wind River valley a few years later, but owing to opposition of local forest officers could not get the consent of the Administrative Branch until he appealed to Assistant Forester Clapp in the Washington Office. However, during the 1927 Investigative Committee meeting, held March 8, 9, and 10, a program of reserving “small” natural areas representative of other forest types was discussed and approved. During the discussion, it was pointed out that this action was “highly desirable in the low altitude commercial types which are being rapidly exploited.”

It was suggested that a small committee be set up to propose and recommend areas which might be reserved as natural areas, and referred particularly to old-growth Douglas-fir, red cedar, Sitka spruce, western hemlock, and yellow pine types. In 1927, District Forester Granger appointed a committee of four, known as the “Research Reserve Committee,” to perform that function. However, it was to take several more years to get this program underway and to develop specifications and procedures for implementation of this policy.

During 1927, a major part of the yellow pine slash disposal study was completed by Westveld and a manuscript prepared and submitted to the Washington Office for publication.

Mainly, efforts of the rest of the staff were devoted to continuation of the other major projects. Ten-year observations on the Douglas-fir plantation of pedigreed stock were available for compilation and analysis, a major “mile-stone” in the heredity studies. Also of note was the development of a plan for keeping phenological records of all tree species, shrubs, and herbs at a number of stations.

Isaac expanded his seed flight study to an eastern Oregon wheatfield, again using kites as dispersal vehicles to the snow-covered field; later, Isaac used pilot balloons instead of kites. Western white pine, western redcedar, and western hemlock seeds were used in addition to Douglas-fir.

McArdle commenced a study of Douglas-fir slash disposal by locating and measuring slash on a series of 24 semipermanent 1-acre plots in the Douglas-fir and "fog belt" mixed spruce-hemlock and fir types of the Olympic Peninsula.[4]

Late in the year, Departmental Bulletin No. 1493, "Timber Growing and Logging Practice in the Douglas Fir Region," by T. T. Munger, was issued. This was one of a series of regional studies initiated at the direction of Chief Forester Greeley to determine the measures needed to remove deterrents to practice of better forestry on private and public lands.

Two interregional yellow pine marking conferences were held in District 6.[5] One was held on the Fremont National Forest with participants from District 5 and the California Experiment Station. The other was held on the Malheur National Forest with District 4 personnel. Although this was primarily an administrative problem and function, research personnel were always present to give technical advice and research viewpoints. Director Munger attended both these sessions. Similar interregional conferences were held in following years to coordinate and improve selection of "cut and leave" trees in the western yellow pine stands of the National Forests. It was not uncommon to find differences of opinion among the several Districts and Stations involved, and in certain cases, the differences were not resolved.

In September 1927, the Station's Advisory Council had a "show me" field meeting at the Wind River Branch in addition to the Regular February meeting in Portland. The Pacific Northwest Forest Research Council, as it was then called, had broadened the scope of its activities to include the programs of the District Office of Products and the Bureau of Plant Industry Portland Office of Forest Pathology, which was housed with the District Office in the New Post Office Building.[6]

Making of a forest type map and a timber inventory of Oregon's forests in cooperation with the State Forester was discussed in positive terms at the Investigative and Advisory Council meetings, and some interest was shown by the State of Washington in a similar undertaking. This subject apparently was stimulated by a vegetative type mapping cooperative program, which was underway in California, with the California Forest Experiment Station, District 5 of the Forest Service, the State Forester, the University's forest school, and other Government agencies and private organizations.

In September of 1927, McArdle took leave without pay to start a graduate study program at his alma mater, the University of Michigan.

Studies in western yellow pine were further strengthened at the Station in 1928 by initiation of a study of growth and yield of this species. Meyer, who was assigned to this project, prepared a bibliography and working plan early in the year, and fieldwork commenced that summer. Ernest L. Kolbe joined the Station staff, chosen from the junior forester rolls in July as a replacement for Westveld, who was leaving in September to join the forest school faculty of Michigan State College.

4 One of the field assistants of the Station was Huxley Coulter, later well known in State and Private Forestry activities.

5 Although this is the first record found of such conferences held in this region, there may have been some held earlier in other western pine districts, or in this district for that matter.

6 This building, located at N.W. Broadway and Glisan Streets, was the main post office in Portland; however, it was labeled "new" since it diferred in age to what is now known as the Pioneer Post Office.

Kolbe and William G. Morris, who was employed as a field assistant, were part of Meyer's field crew. Later in the summer, Morris assisted Westveld in the yellow pine slash disposal study. Plantations of pedigreed yellow pine stock were established at several locations on the Deschutes, Columbia, and Whitman National Forests and at the school forests of Oregon Agricultural College, University of Washington, and Washington State College.

Additional emphasis was given western hemlock growth studies when the first permanent sample plots in pure hemlock were established on lands of the Crown-Willamette Paper Co. (later, Crown Zellerbach Co.) in the "fog belt" of Oregon.

The first published results of the Douglas-fir growth and yield study appeared in an article in the West Coast Lumberman of May 1, 1928, by R. E. McArdle, entitled, "Rate of Growth of Douglas Fir Forests."

This trade journal and The Timberman included articles based on Federal forest research as a matter of practice for several years prior to this. This was an effective medium for early publication of progress in forest research and these two journals were widely circulated through the western forest industries. George M. Cornwall,[7] the publisher and editor of the Portland-based Timberman, was an early advocate of scientific forestry and did much to advance enlightened management and utilization of western forest resources.

Until 1928, forest economic research in the Pacific Northwest had been largely limited to collection of lumber and log production and price data and surveys of forest industrial logging and manufacturing practices, with some attention given to marketing problems. A turning point took place in that year with two significant studies. One was initiated by the Western Forestry and Conservation Association with inputs[8] of scientific findings from Station going projects. This project was an intensive study of forest-land use and related silvicultural, forest protection, and timber utilization problems in the economy of Grays Harbor County, Washington.

The other study was the "Forest Taxation Inquiry," a nationwide project of the Forest Service with the forested Western States a principal area of study. This project was directed by Professor Fred Fairchild of Yale University, the leading authority on forest taxation and a noted economist. Starting in the Pacific Northwest in June, the fieldwork was completed in December. Dr. Fairchild was assisted in the fieldwork and subsequent analysis by R. C. Hall, P. A. Herbert, and Daniel Pingree. Fairchild presented his study plans and objectives to the Forest Research Advisory Council at a special meeting in Tacoma in August 1928, seeking advice and endorsement. A further example of the active functioning of the Council was a joint meeting of the Forestry Committee of the Portland Chamber of Commerce in October, specifically convened for a presentation by Dr. Haven Metcalf, Chief of Forest Pathology, Bureau of Plant Industry, U.S. Department of Agriculture, Washington, D.C., of the dangers of the European larch canker disease which had been discovered in eastern forests. Fortunately, this tree disease did not become a major problem in this region.

7 Mr. Cornwall was a trustee of Oregon Agricultural College and a favorite guest speaker at the Pacific Coast forest schools.

8 "Inputs" is a word not commonly used in economic vocabularies at that time, but is now in popular use.

Closely related to economic research was the logging waste study; fieldwork on this project was finished and computations completed early in 1928. Later in the year, draft of the final report was prepared by Hodgson.[9]

Overshadowing all these accomplishments was the enactment by Congress of the McSweeney-McNary Act of May 22, 1928. This was and remains the most important Federal legislation related to forest research. It contains 10 sections which provided the basic framework for the organization of regional Forest Experiment Stations and named and described the following broad fields of study in separate sections: "forest diseases; forest insects; forest animals, birds, and wildlife; forest fire weather; forest range and watershed; forest products; forest survey; and forest reforestation and economic studies." Annual amounts were authorized for each of the eight fields of study and an overall ceiling was placed on the original forest survey. These amounts seemed generous at the time, particularly when compared with the amounts previously appropriated. As time passed, they proved inadequate and the basic act was amended and supplemented a number of times. However, it still stands as an example of prescient and progressive forest legislation.[10] Senator Charles L. McNary of Oregon was behind this legislation in Congress. At the time, he was in his second term and the acknowledged national leader of forest legislation. Other Oregon and Washington senators and congressmen have followed in his footsteps as leaders in forest legislation.

Actual appropriations were not made under the McSweeney-McNary Act until the fiscal year commencing July 1, 1929. In anticipation of funds forthcoming for the forest survey under Section 9 of the Act, Munger went to Washington in January 1929 to review plans for the forest survey with Washington Office research personnel.

Prior to this time, the nature of the proposed forest inventory had been discussed with the Advisory Council and the Investigative Committee. Both of these groups strongly supported Munger's belief that a forest type map was an essential part of such a project. An allotment of $30,000 for the forest survey was made effective July 1, 1929. This doubled the financial funding for the Station. Staffing commenced immediately with the appointment of Philip A. Briegleb from the junior forester rolls on July 1. Briegleb was detailed to Wind River to work on projects there until the forest survey plans could be finalized. On November 5 of that year, Robert W. Cowlin was appointed as an associated forest economic and Floyd L. Moravets was transferred from District 6 as a junior forester to serve on this project, and Edith A. Parmeter was appointed October 14 as junior clerk to complete the staffing for that year. The remainder of the year this group reviewed literature, defined forest types, investigated sources of information, and commenced preparing working plans under the direct supervision of Director Munger. It was planned to divide the forest survey into four phases, which were: the timber inventory, forest growth phase, forest depletion, and the requirements for forest products. This was in accord with the language of Section 9 of the McSweeney-McNary Act. The Douglas-fir region, the area west of the Cascade Range summit in Oregon and Washington, was selected from all other forest regions of the country as the starting point for this important new project. Since this project was to be extended to other forest regions in future years, considerable attention was directed to the plans

9 An office report, 179 pages, 1929, "A Survey of Logging Waste in the Douglas-Fir Region," U.S. Forest Service, District 6. Also published in the West Coast Lumberman and The Pacific Pulp & Paper Industry in a series of issues in 1930.

10 "A National Program of Forest Research," published in 1926 by the American Tree Association for the Society of American Foresters, furnished a "blueprint" for this legislation. It was prepared by Earle H. Clapp as a special report of a special committee on forest research of the Washington Section of the Society of American Foresters. Other members of the committee were R. C. Hall and A. B. Hastings. However, many other foresters, entomologists, plant pathologists, and wood technologists contributed to it. It made an analysis of the forest problems of this country and research needed to solve these problems. It went into great detail of the kinds of research needed, its complexities and interrelationships. The report described existing agencies—private, public, educational, and institutional—and current programs and discussed agency needs and responsibilities. It drew certain conclusions and made suggestions for an organic act for forest research in the U.S. Department of Agriculture.

and procedures developed and executed here. Furthermore, this region, despite the fact that it contained only about 30 million acres of commercial forest land, was known to have a major share of the Nation's remaining saw-timber volume, most of it in old-growth stands. Since the National Forests contained a large part of the forest-land acreage and timber volume, there were prospects that the historical trends of forest resource depletion in the Lake States, East, and South might be averted here. Also, the private lands of this region were generally located in the areas of higher productivity, and there were indications of interest in holding timberlands for continuous timber production by some owners. One of the factors arousing this interest was the passage of "the reforestation land tax bill" by the Oregon Legislature in March 1929.[11] The Fairchild study definitely had some influence in awakening public awareness of the adverse effect of current property tax laws and practices upon private forest-land ownership and management.

Walter H. Meyer returned from educational leave at midyear, armed with a Ph.D. degree from Yale University, to resume growth and yield studies of Douglas-fir, western yellow pine, and western hemlock. McArdle, also on educational leave, returned for a summer's fieldwork on fire studies, returning to the University of Michigan in the fall for completion of his graduate study program and award of a Ph.D. degree.

The Bureau of Entomology and Plant Quarantine established a forest insect field station in Portland in 1931 to conduct research programs and give advice to the Forest Service and other agencies engaged in insect control programs. Outbreaks of the western pine beetle in the late twenties caused Jack Kimball and E. T. Allen to solicit Senator McNary's help in obtaining funds which he obtained as an item of "personal privilege." F. P. Keen, an experienced forest entomologist, was put in charge, assisted by James A. Beal. The new station was located in the Lewis Building in a room adjacent to the Experiment Station. Finances were skimpy and the entomologists had to depend upon the Station for clerical help and advice concerning fiscal matters and administrative regulations.

The sudden collapse of common stock prices on the New York Stock Exchange signaled the beginning of an economic depression that was to endure nearly a decade and that was to result in numerous radical changes in the Nation's economic and social structures and political institutions. Forest resource management, the forest industries, and forest research programs were influenced in a number of ways by the economic forces at work and by Governmental actions.

For several years before 1929, lumber production nationally had been declining. In the Douglas-fir region, volume of lumber production had remained practically stationary from 1926 to 1929. There were signs that the postwar boom of the twenties had run its course. Lumber prices were weakening under slackening demand. Many timber companies were financially overextended with burdensome debt charges on bonded indebtedness. Installed capacity was greatly in excess of that needed to supply national demand. Lumber production nationally declined from 37 billion board feet in 1929 to 26 billion feet in 1930, and the bottom was not in sight. During the same 1-year period, production in the Douglas-fir region dropped from about 10 billion board feet to 7.5 billion board feet. Since the timber industries were by far the leading manufacturing industry in the Pacific Northwest, the impact of this region's economy was severe.

With this stage setting, a strengthening of the economic aspects of forestry in the Station's research program commenced in 1930. The funds allotted to the forest survey more than doubled and other new projects of an economic nature were planned.

On January 6, 1930, Horace J. Andrews was appointed senior forest economist to provide the leadership of the forest survey project. On the same day, Donald N. Matthews was transferred from the Umpqua National Forest of District 6 to assist on the survey. "Hoss" Andrews was particularly well qualified for this position. A graduate of the

11 This law provided the landowner with the option of having cutover land suitable for reforestation classified and withdrawn from ordinary operation of property taxation. The classified lands would pay 5 cents per acre annually and a harvest tax when the merchantable crop was cut.

School of Forestry, University of Michigan, he was Director of the forest land and economic survey of the Michigan State Conservation Department in 1924 and 1925. Following this period, he was Chief Fire Warden and in charge of the State of Michigan Division of Lands until he left to join the Station.

January 1, 1930, District Forester Christopher M. Granger was appointed as Head Forest Economist to be the national director of the forest survey, and later in the month moved his office from District 6 headquarters to the Lewis Building in the Experiment Station suite. With the principal staffing of the survey group completed, the working plan could be developed and fieldwork commenced. A "Digest of the Tentative Working Plan" was prepared for presentation to the Forest Research Council and mailed to members on February 14 a week before the scheduled annual meeting.

Exploration of existing information that might be used in the survey had disclosed that private and public timber cruises were in existence covering practically all the stands of mature commercial timber on lands other than the National Forests and National Parks. From these records, forest type and tentative timber volume could be determined in the office. Field crews type mapped the remaining area, consisting principally of cutover lands, deforested burns, and second-growth stands, by traversing roads, trails, and logging railroads and occupying vantage points. Occasional patches of remnant old-growth forests not covered by records were assigned saw-timber volumes by ocular estimation by the type mapper. Records of areas cut over by date of logging and area of recent deforested burns were available in a number of sources such as State Foresters' offices, fire protection associations, county assessors, and timber owners.

In contrast, the National Forest timberlands were only partly covered by intensive surveys, and these were commonly made in areas where timber sale programs were active. Accordingly, a somewhat different procedure was employed on the National Forests than was used on private lands, although the basic objectives and forest type and timber volume specifications were identical, assuring that the data would be additive. On all lands, each unit of commercial forest land was classified by forest type, site or productivity class, and ownership class, and was assigned a sawtimber volume value for each species if of merchantable quantity. Second-growth stands were classified by 10-year age class and three degrees of stocking; from these data, board-foot and cubic-foot volume could be determined by applying the appropriate yield table. Deforested burns and nonrestocked cutover lands were classified as such with the exception of lands cut over within 10 years of the date of the survey which were designated as "recent cutovers." The reasoning was that since Douglas-fir, the principal species, did not produce adequate seed crops each year, no immediate judgment could be made on restocking. At this time, practically all timber harvested was by clearcutting with defective trees[12] left standing which furnished a seed source.

Noncommercial forest lands were classified by ownership class only. Forest lands withdrawn from cutting by statute, such as national parks and primitive areas, were designated as reserved and although timber volume values were assigned to such lands, they were declared unavailable for cutting.

Each National Forest was divided into working circles and compartments. The county was the basic area unit used for lands of other ownership, and forest type and timber volume data were gathered and compiled by township and section. The smallest areal unit recognized in classifying by land use, forest type, or ownership was 40 acres. This survey procedure, commonly called the "compilation method," was a contrast to forest survey methods used in European countries such as Sweden and Finland where linear-plot surveys had been made on a national scale. This system consisted of measured plots of a fixed area at certain distances along lines at spaced intervals. Sampling accuracy of the resulting timber volume and forest type or land use area could be determined for large political units such as provinces. On the other hand, the compilation method was not susceptible of accuracy determination and specification by statistical analysis. However, since the region's forest area was to be completely covered by the survey, it was reasoned there would be no sampling error as far as area values were concerned. Obviously, there could be personal errors and bias on the part of field crews, which was also true

12 These trees were culled owing to a high incidence of decay in the lower trunk as a general rule. Such trees were not genetically inferior to the trees that had been harvested.

of surveys by any other method. The fact that forest type maps and localized area and volume data could be obtained by the compilation method outweighed other considerations in the judgment of the Director and survey leaders and this method was adopted. The linear survey system could only yield schematic type maps and generalized area and volume data at the intensity permitted by funds available for the project.

At the annual meeting of the Forest Research Council in February 1930, plans for conducting the forest survey were presented. An entire afternoon was devoted to discussion of the methods to be used, timber volume and area specifications, and how the information was to be released to the public upon completion of the survey. Some members advocated compilation of the data by large watersheds rather than by county. Generally, those advocating this position represented private timberland owners who feared that release of timber volume data by county would prompt taxing officials to increase assessed valuations of private forest land and timber.

During World War I, corporation Federal income tax rates increased tremendously. This required a great expansion of Federal auditing of returns of timber owners, including the valuation they placed upon their timber holdings.[13] The owners were directed to evaluate their timber by quantity, character, and value as of March 1, 1913. Some owners chose to provide the forest survey with this information instead of more recent data. And, too, some private owners, particularly nonoperating owners, had only rough estimates of their timber holdings.

The specifications for merchantable timber volume adopted as a regional standard for the survey were generally more rigid than those used in commercial private cruises and in cruises used by the counties for tax assessments. At that time, practically all the county cruises were made by commercial timber cruising firms under contract. Specifications and degrees of statistical reliability of the county cruises varied. Cruises made recently of private timber likewise varied, although generally they were more uniform than the county cruises. However, it was reported that there were substantial differences in timber volume if they were “buying” or “selling” cruises. Practically all the cruises, both county and private, underestimated the volume of the minor species, and in some cases ignored it completely. Timber volume was rarely estimated for the hardwoods, which often occurred as an understory in the conifer old-growth stands or in pure hardwood stands along the river bottoms and other favorable sites.

Obviously, the survey would have to adjust the timber volume data collected from the timber owners and the counties. In nearly all cases, this would mean an increase in total merchantable timber volume for the particular area of forest land covered. Some council member suggested using private cruises only as a sample to adjust county cruises. One member voiced the opinion that release of timber volume estimates by counties might cause county officials to have recruises made. Chairman Chapman suggested that the Station collect the data and decide later how it would be released. Other council members pointed out the advantage of having these data by county in planning forest resource development and management. It was pointed out that other economic data were available by county units. However, the Station agreed that all private timber cruise data used would be kept confidential and that it would not be released in any form that would disclose the timber holdings of a single private owner, and that the unit area of release would be the subject of future discussion and decision. Moreover, the Station agreed to qualify the timber volume data released by explicitly defining the standards used which exceeded current commercial practice and therefore was not necessarily economically available. The question of classifying private forest land and timber by accessibility zones was raised and discussed. The British Columbia Forest Service was also conducting a forest survey of the province at this time. Mr. F. D. Mulholland, who was directing this survey, was present and described their system which classified timber volume on the basis of two classes of economic availability.

13 In 1919, David T. Mason was appointed to organize and head the timber valuation section of the Federal Bureau of Internal Revenue.

Granger, Munger, Andrews, and Cowlin attended a meeting of the Forestry Committee of the West Coast Lumbermen's Association to present the plans for the forest survey and discuss them with committee members. The meeting was called by Colonel Greeley,[14] who had resigned as Chief of the Forest Service in 1928[15] to become executive head of the association. The "Colonel," as he was respectfully and affectionately known by foresters and timbermen, undoubtedly had considerable influence in the high degree of cooperation which the Station obtained from the timber industry in launching the forest survey. His influence was also a positive factor in support of many other Station programs and in gaining the endorsement of the association for the Station generally.

A detailed work plan and fieldwork instructions for the forest survey were completed during the early part of 1930. The first step was location and investigation of sources of information. Lists of large private timberland owners and approximate acreage owned were compiled from several sources. Sources of base map information were located and collection of maps of each county on a 1-mile-to-the-inch scale commenced for use in field type mapping of lands other than National Forests. The Forest Service District Office of Maps and Surveys had on file maps for each of the National Forests. With financial aid from State forestry departments of Oregon and Washington, work was commenced upon compiling the most recent cartographic data to draft new base maps of the two States on a 1/4-inch-to-the-mile scale.

The actual fieldwork of the survey was divided into two sections. Donald N. Matthews was placed in charge of the National Forest section. One or two men from the staff of each National Forest in the Douglas-fir region was assigned to the project. For areas not covered by intensive surveys made for timber sale preparation or land classification and exchange purposes, a field examination was made which consisted of a type map and a timber volume estimate. This was described as an "intensive application of an extensive reconnaissance"[16] (a use of words which might cause a semanticist to wince). About 1920, an extensive reconnaissance of the National Forests in the District had been made and timber volume estimated and compiled. This provided a starting point for the detailed forest survey.

Supervision of the office work and fieldwork on lands other than the National Forests was assigned to Cowlin. Timberland owners were contacted and asked for use of their timberland information. County assessor offices were visited and the job of collecting timber cruise work commenced before mid-1930. Washington County, on the outskirts of Portland, was selected as the first county to be covered, and Briegleb was assigned to it after a brief field training period conducted by Andrews with Cowlin, Matthews, Briegleb, and Moravets to test procedures. Other field tests were made with Munger and Granger as participants to settle final plans for the work. A field school in estimation of defect in Douglas-fir was conducted by Dr. Boyce[17] in early fall for members of the survey staff on the Cascade National Forest near Westfir, Oreg.

With additional funds in sight for fiscal year 1931, three additional men[18] were selected and transferred from other Forest Service Districts shortly before June 30. These men were young professional foresters. Each was assigned a county to work under Cowlin's supervision after a training session. Moravets, who had done a large part of the data collecting process, was also assigned a county.

14 Following World War I, Greeley was commonly referred to by his military title.

15 He was succeeded by Major R. Y. Stuart.

16 An extensive reconnaissance had been made of all Pacific Northwest National Forest lands in 1920-23 to provide timber volume data for the Capper Report.

17 Dr. John S. Boyce transferred from the Bureau of Plant Industry March 1, 1928, to become Director of the Northeastern Forest Experiment Station, U.S. Forest Service, Amherst, Mass. One year later, he resigned to become the first Professor of Forest Pathology at the School of Forestry, Yale University. In 1923, "Decay and Other Losses in Western Oregon and Washington," U.S.D.A. Technical Bulletin 280, 60 pp., illus., was published under his authorship.

18 Edward D. Buell, Warren H. Bolles, and Paul D. Kemp.

For convenience in the field and facility in compilation and interpretation of the forest survey inventory, growth, and depletion data, the Douglas-fir region was divided into 11 subregional geographic units. With one exception, each of these units contained two or more counties. Generally, one field man was assigned one of these subregions, or units as they were called. As funds permitted, they were provided with field assistants.

It was evident that the problem of adjusting the timber estimates on private lands to a common standard called for special expertise. With this need in mind, James W. Girard[19] was added to the forest survey staff July 1 as a senior logging engineer. Jim Girard had worked for the Forest Service in other Districts as log scaler, timber-man, and logging engineer, and had also worked in the timber industry in similar capacities. He was more or less self-educated, but had not only acquired a wealth of practical woods experience, but had also grasped the fundamentals of forestry by observation and association with professionals. He had an unusual faculty for judging timber volumes by ocular estimation and applying this information to large areas by extensive observation. In the years to come, after working in all parts of this country and some foreign countries examining large tracts of timber, he became a legendary figure among timbermen, if anyone merits this description.

Gerard worked out plans for adjusting the timber cruises used by the forest survey and described the qualifications for the personnel to do this work. The Civil Service Commission, upon representation by the Forest Service, agreed to hold a special examination for a position called “timber expert.” It was classified as the equivalent in grade to an associate forester, or P-3 as it was known in the vernacular of the Civil Service.

In the fall of 1930, three timber experts were appointed from the roll established by the examination, which was unassembled. They were Charles W. Kline, William J. Wakeman, and Percy N. Pratt. The first two named were forest school graduates, qualified logging engineers, and with a background of employment in the timber industry. Pratt was a member of a Portland timber cruising firm, Pearson and Grady, and had many years of practical experience.

Work on all parts of the inventory phase of the forest survey could now proceed full steam ahead with the opening of the field season in 1931.

The forest insurance study also got underway in 1930 with the transfer of Harold B. Shepard, senior forest economist from the Washington Office of the Forest Service, on July 1. Work commenced in the Douglas-fir region, and it was planned to extend its application to other forest regions, depending upon the findings of this study, which was the first systematic study of this subject undertaken in this country.

Near the end of 1930, Professor Burt P. Kirkland of the College of Forestry, University of Washington, was employed by the Station on a part-time, temporary basis to plan a study of the economic aspects of forest management and timber harvesting. The understanding was that after the close of the academic year, June 1931, he would become a permanent member of the Station staff. Kirkland had been with the Forest Service for many years prior to joining the University of Washington faculty and had engaged in other studies in the economics of forest management.

Fire studies were broadened and intensified with additional financing from fiscal year 1931 appropriations. Dr. Richard E. McArdle reported back to the Station in June after completing graduate studies at the University of Michigan to resume active direction of the fire research program.

Fire behavior studies of large conflagrations continued to accumulate information on the influence of fuels, weather, and topography on spread. A satisfactory technique of measuring these factors had been developed, facilitating observations of going large fires.

19 Girard also participated in the Westfir training session with Dr. Boyce.

The study of lightning storms continued in an effort to determine methods and instrumentation needed to forecast accurately occurrence of this weather phenomenon. Use of radio static, studied by Simson under Hofmann's direction and later under McArdle, proved unreliable. This led Simson to design and construct five static meters to forecast lightning storms, which were a principal cause of fires in the Cascade Range, Blue Mountains, and Wallowa Mountains. The five static meters were placed in the fire dispatcher's office in four Oregon National Forests and one Washington Forest to test their effectiveness. McArdle designed a stick made of Douglas-fir to measure forest fuel moisture during the fire season. Properly prepared and calibrated, these sticks allowed determination of moisture content changes when periodically weighed. This simple device proved to be an effective tool in fire weather determination.

For several years prior to this time, S. B. Show and E. I. Kotok[20] had been developing a fire control strategy called "hour control" in Region 5 of the Forest Service. This study involved a punchcard analysis of many fires on National Forest lands in the West. McArdle participated in a conference held in Berkeley in the fall of 1930 to plan the extension of this study. Other participants in addition to Show and Kotok were H. T. Gisborne of the Northern Rocky Mountain Station, Missoula, Mont., and L. H. Reineke of the California Forest Experiment Station, Berkeley, Calif.

Following this conference, McArdle worked with the Region 6 Office in Portland in planning collection and analyses of fire reports in the Pacific Northwest. Fire damage studies in the Douglas-fir region were commenced by the Station to develop information needed in the "hour control" study and the forest fire insurance study.

An outstanding accomplishment in 1930 was the publication of "Yield of Douglas-Fir in the Pacific Northwest," by R. E. McArdle and W. H. Meyer, U.S. Department of Agriculture Technical Bulletin 201. This publication has been a basic tool for practicing foresters, public and private, in this region for many years. It supplied information needed in determination of allowable cuts under sustained yield management of old-growth Douglas-fir and for scientific management of second-growth stands of that species.

The issuance of Administrative Regulation L-20 by the Washington Office of the Forest Service gave official impetus and authority for the setting aside of National Forest lands for experimental forests and natural areas. The Experiment Stations had sought these objectives for a number of years as necessary installations for a controlled and comprehensive Federal forest research program. An in-Service committee was organized with Munger as chairman and four members from the District Office, E. N. Kavanaugh, J. V. Horton, F. E. Ames, and E. J. Hanzlik, and McArdle from the Station. This committee succeeded the virgin timber reserve committee, which had functioned more or less informally for several years. Initially, the committee decided that two experimental forests would be established, one in the Douglas-fir type in Wind River valley and the other in the western yellow pine type on the Deschutes National Forest near Pringle Falls on the upper Deschutes River. The committee also considered proposals for four natural areas, each representing a major forest type, for consideration after reports of field examination were received.

Fieldwork was completed in the fall of 1930 on growth and yield of western yellow pine after three seasons of fieldwork in eastern Oregon and Washington. Upon completion of the fieldwork, computation of the data commenced and proceeded through the winter of 1930-31. In the pre-electronic data processing era, this was a laborious process. Several temporary computer clerks were hired to speed up the process, using manually operated adding machines and desk calculators. It was customary in those times for student field assistants and permanent staff foresters to spend the evenings after fieldwork transcribing notes and preparing field records for final computation. Fleshpots were few and far between in the area at that time, use of Government vehicles for

20 At this time, Kotok was Director of the California Forest Experiment Station in Berkeley and Shaw was Regional Forester, Region 5, San Francisco, Calif. In 1930, National Forest Administrative Districts and District Foresters' titles were changed to Regions and Regional Foresters, respectively.

frivolous reasons was prohibited, and expense accounts were closely scrutinized by June Wertz, the chief clerk of the Station. These conditions stimulated the field crews into getting on with the job, regardless of hours of work—overtime was merely a word of no fiscal meaning.

The effects of the Great Depression began to influence Station activities early in 1931. The Station was ordered to withhold expenditure of a portion of appropriated funds during fiscal years 1931 and 1932. In addition, restrictions were placed on promotions, filling of vacancies, and travel. At this time, there was no provision for automatic periodic salary step increases within a Civil Service grade. As a result, salaries of appointed clerical and professional employees were at a stationary or reduced level for a number of years. In July 1932, annual leave was canceled and the "Hoover Holiday," which consisted of 2 days off each month without pay was instituted. Despite these draconian measures, morale of Station personnel remained high; work output did not suffer as many employees did not exercise their rights to the "day off." A moderating condition was the cost of living which did not increase and for some items of necessity decreased in cost.

With the funds available, the forest survey was able to step up its activities and recruit half a dozen or more temporary field assistants, either experienced timber cruisers or graduate foresters who could not find other employment. These men were principally used for the job of adjusting private and county timber cruises; some of them served as compassmen for the permanent staff of "timber experts," and others of greater experience worked in the same capacity as the staff cruisers after a short training period in survey techniques and standards.

Late in 1930, G. H. Lentz of the Southern Forest Experiment Station, which was scheduled to initiate the forest survey in the Southern forest regions, spent some time in Portland reviewing Pacific Northwest methods and problems. He also reviewed with Granger and Girard forest conditions in his area as they related to survey methodology. Lack of existing timber volume information in county (or parish in Louisiana) records and in possession of the many small owners precluded adoption of the compilation method as used in the Pacific Northwest. The more favorable topography and uniformity of stands, absence of areas of high-volume, old-growth forests compared with the Douglas-fir region, and the vast total area of forest land were factors that favored the linear method of survey, and the conclusion was reached to use that method in the South.

This action revived the question of using the linear method in the Douglas-fir region in the minds of Washington Office personnel and Granger. Consequently, it was decided to make a comparative test of the two systems in this region. Lewis County, Washington, one of the larger counties in the region, was selected as the area to be used and work plans were made for the fieldwork. This county extended from the crest of the Cascade Range on the east to the Coast Ranges on the west and included a variety of forest conditions and topography. That portion of the county within the National Forest boundaries was not included since the survey method used for the National Forests was not susceptible to comparison. There was no other choice of method for such forest lands with the funds available because of the rugged nature of the terrain, short field seasons, and relatively poor accessibility.

The test area consisted of 40 townships, approximately 1 million acres, extending from the National Forests[21] on the east to the county boundary on the west. Linear strips were spaced at 3-mile intervals across the county in an east-west direction. Timber volume was estimated on quarter-acre circular plots at 10-chain (660 feet) intervals. Forest type changes were recorded whenever intersected by the strip; however, no length of strip less than approximately 2 chains was considered. Fieldwork was started in January 1931 with a crew consisting of Briegleb, Pratt, and Fire Warden George Herger who was assigned by State Forester Joy of Washington to help on the project. This crew, working in the more accessible part of the county's mixed farm and forest land, tested the techniques. A final working plan based on this crew's experiences was prepared. Fortunately, the winter, although unusually rainy, was not cold, and there was little snow in the low-lying hills of the Chehalis River valley. Later in the year, other crews were added until practically the entire forest survey crews working on the private lands, and some from the National Forests, were in Lewis County. Some crews were composed of three men, and in the more

21 An isolated block of National Forest land called the Mineral Addition was included in the test area.

accessible country two-man crews could be used. All in all, 16 men (not including overhead personnel) were employed on the Lewis County strip survey for 960 man-days in the field, and 900 of these days were spent on the line regardless of weather. Packers, horse and human, were needed in some locations, and line camps could seldom be occupied more than one night. The 8-hour day was unheard of, for in some instances it would take several hours or more to reach the line in the morning and a like amount of time or more to reach the camp, night lodging place, or automobile at the end of the day. In a few cases, crews "bundled" up for the night on the line. Wherever roads permitted, automobiles were used to reach the vicinity of the fieldwork location. Review and transcription of field records was done at night usually, although in a few locations where several crews were quartered in a small-town hotel, it was rumored that penny-ante poker games were an occasional diversion.

Girard spent considerable time in Lewis County after he returned from the South about the first of April. He worked with Kline who was doing the cruising for adjustment of the county and private cruises used in the compilation method. He also spent a few days with some of the crews on the strip survey. Andrews and Girard took over field responsibility for several miles of strip in rough country near the end of the job, spending overnight camping on the line. They claimed a record for ground covered in the allotted time. Director Munger spent a day with one of the strip crews and another day with Girard and Kline on the adjustment cruising.

Buell was responsible for the type mapping portion of the compilation method survey of Lewis County. Working all through the winter on this job, he completed his assignment in April. Cowlin spent considerable time with Buell, and Andrews and Cowlin both worked with the strip crews, visiting each of them together or separately at least once during the course of the work and usually spending 2 days with each crew.

F. X. Schumacher,[22] then on the staff of the Washington Office as a mensurationist, visited the project for several days and was out on the line with Cowlin and the crew headed by Moravets for a strenuous time in rough country. "Schu," as he was known to many, had been successful in a poker game over the weekend at a hotel where a group of the men were staying in Chehalis, the county seat of Lewis County. The next day proved to be "blue" Monday for him as Moravets and Cowlin evened the score by wagering on tree diameters before they were taped. Schu had a tendency to underestimate the large old-growth Douglas-fir.

All of the fieldwork in Lewis County was completed the last half of June. Under Cowlin's supervision, office computations had been organized on a current basis as field records were available. Buell finished computation of the forest type and timber volume data gathered by the compilation method in June for all of Lewis County with a separate summary for the 40-township test area.

Upon completion of the strip survey and computation of the data for the test area in July, Meyer analyzed the sampling errors of the various areas by statistical analysis. It soon became apparent that a reasonable sampling error could be obtained for broad groups of data only. Innumerable combinations of forest type area, site class, stand class, timber volume by species and ownership could be made, but a valid comparison of the two methods could only be made for major items for unit areas as small as a million acres.[23] The comparison showed that for areas of major forest types the two methods were reasonably close, particularly in consideration of the unavoidable differences in field definition of types. The strip method picks up small openings of hardwoods, brush, waters, etc., too small in extent to map in place.

Sawtimber volume estimates by the two methods were reasonably close with the exception of hardwoods. This pointed the way for a refinement in the compilation method to allow for hardwood volume occurring as an understory in the conifer types and for small stringers along stream courses.

22 Francis X. Schumacher was a member of the faculties of the University of California and Duke University teaching forest mensuration. He published many articles on growth and yield of California conifers and sampling methods and a text and reference book with Donald Bruce entitled "Forest Mensuration," McGraw-Hill, New York and London, 1933. 360 pp., illus.

23 A number of counties in the Douglas-fir region were less than a million acres in total land area.

Forest site data for the area by the two methods were very close.

Growth estimates which had been calculated by Meyer were in a reasonable range for the two methods for both total board-foot and cubic-foot volumes, but varied widely for components of ownership and species.

Clapp and Granger came to Portland to participate in the discussion of this test of methods. The decision was made to continue the compilation method, not only for the Douglas-fir region but also for the ponderosa pine region of the Pacific Northwest. The forest survey of the Northern Rocky Mountain region was scheduled to start soon and the compilation method was adopted for that area.

Considerable detail has been accorded this episode in the nationwide forest survey, since it was a unique project in forest research and was precedent setting in treatment of forest resource data. One distinction that bears emphasis is that the size of the unit area for release of forest resource information was not a controlling factor in the compilation method of making surveys as it was in the linear method.

Future sophistications in statistical analysis, data processing, sampling techniques, and aerial survey techniques altered the situation. However, events of the next two decades proved the usefulness of having localized forest resource data for the Pacific Northwest region, a keystone in studies of the Nation's forest resource situation and development of programs of national and regional scope.

Aerial photography in making forest surveys was still in an experimental stage of development at this time. It had been used to some extent in eastern Canada, and the British Columbia forest survey group was studying its use. The latter organization was using amphibious planes extensively to transport men and supplies to interior inaccessible portions of the province. In 1927, Lage Wernstedt,[24] attached to the Region 6 Division of Maps and Surveys, photographed rugged portions of the Mount Baker National Forest from the air, using oblique shots. The film used at that time produced photos that were fuzzy and did not give clear distinction of the forest cover.

Early in 1931, Andrews, Cowlin, and Briegleb made a field study of the usability of a series of vertical aerial photographs taken by Fairchild Airways transecting a township of mixed forest and farm land in Clackamas County, Oregon. Fairchild Airways was a pioneer in promoting the use of aerial photographs in many forms of land use examination. Andrews, Cowlin, and Matthews also studied the use of aerial obliques taken by Lage Wernstedt of another area. Later in the year, Wernstedt photographed a considerable portion of the Siuslaw National Forest in the Coast Ranges of western Oregon. These mountains, although not rising to high altitudes, were greatly dissected by stream courses and ridges. Forest types, although predominately Douglas-fir except near the coast where western hemlock and Sitka spruce dominated, were interspersed with hardwoods, usually red alder *(Alnus rubra),* and open areas of braken fern and grass. Age classes of the conifers were mixed. Passable roads were infrequent and vantage points where the field crews could overlook large areas were scarce, owing to the topography and density of vegetation. In this situation, the aerial oblique photos served as a feasible and useful adjunct to field type mapping.

Results of the comparison and study of the application of both vertical and oblique photos led to the conclusion by the forest survey staff that although there was a great potential use of forest aerial photography, it could only be used in this survey in a limited manner. With funds available, original vertical photography was prohibitive, and with a few exceptions the less expensive oblique photographs were also too costly. There were few or no aerial photographs taken for other agencies available, as was the case in later years. Sensitive types of film and sophisticated photo interpretation techniques and accessory equipment had not been developed, although it was probable that considerable research in this field was being initiated and conducted by the military agencies even at this early time.

24 Lage Wernstedt, a Swedish born and educated forester, had an absorbing interest in aerial photography. Later in his career, he was on the supervisors staff of the Mount Baker National Forest as an assistant forester and continued his aerial photography work.

Funds appropriated for forest economic studies in fiscal year 1931 permitted an additional expansion of forest economic studies. January 14, 1931, Axel J. F. Brandstrom, formerly on the faculty of the College of Forestry, University of Washington, was appointed as a senior forest economist. He was assigned to a project named "Financial Aspects of Forestry," and commenced a study of the economic practicability of group selective logging in the Douglas-fir region. The first work was oriented largely to mature and overmature Douglas-fir types. Fieldwork was commenced the summer of that year with the employment of a score of field assistants under the direction of Brandstrom and Kirkland who joined the Station staff on a full-time basis in July 1931. The two men had previously collaborated early in the year on the preparation of a detailed working plan. Most of the time during the course of the fieldwork, headquarters were maintained at the university in Seattle, a matter of convenience and economy since fieldwork centered in western Washington. Time and cost studies were taken at 45 settings, sampling seven different types of logging including a caterpillar tractor operation of the Simpson Timber Co. near the Puget Sound. In all, 40 million feet of logs were covered in the study. Computation of the field data proceeded concurrently, about half done manually and the remainder using the Hollerith tabulation equipment. In the fall of 1931, approximately 1,000 acres of old-growth timber in the Columbia National Forest was selected to apply results of Brandstrom's logging cost data in making an intensive selective appraisal of stumpage values. The Regional Office of Forest Management (later called Timber Management) and the Station cooperated in making a 100-percent cruise of all trees 10 inches and larger in diameter at breast height (d.b.h.). A separate tally of 1 1/2-, 2 1/2-, 5-, 10-, and 40-acre units was recorded in order that a detailed analysis could be made of varying degrees of unit area selective removal.

Previously, Herbert E. Hessler, a consulting engineer, was retained to make four mill-scale studies of Douglas-fir saw logs. These were completed and available for use with the logging cost data in the applied phase of Brandstrom's study. The conclusion was made that the commercial log grades then in use did not provide a sound basis for appraisal of standing timber values. These studies did call attention to the need for more intensive research in this subject.

Early in the year, Shepard reviewed plans for the forest insurance study with a number of interested and knowledgeable persons and agencies. Rating principles used in insuring other types of property were studied and discussed with people involved in these activities. The matter of climate rating received special attention. Collection of data related to evaluation of specific hazard of fire loss commenced.

District fire wardens of the forest protection organizations, public and private, were interviewed by men from the State Forester's staff of Oregon and Washington contributed to assist this research project. A record was made of each fire covering 50 acres or more during the preceding 5 years. A sampling of the larger fires in the field to determine nature and extent of damage was done by field assistants employed by the Station. Crew leaders were experienced cruisers selected for special qualifications for the job, and other crew members were usually graduate foresters. The Depression had mixed benefits; a large labor pool of qualified men was available for forestry work, and there was some loosening of funds from several sources directed toward relief of unemployment. Incidental costs, travel, and supplies were comparatively low.

Weather Bureau records were compiled by a Station staff member to analyze climate factors of precipitation, drought, relative humidity, wind, temperature, and evaporation. Upon summarization of these data, Shepard integrated the various factors and developed climatic zones of relative fire hazard. E. H. MacDaniels of the Regional Office, who was responsible for the Clark-McNary cooperative fire protection program, was loaned to the Station for the grading of fire protection efforts in force in the region. This was a sensitive subject, and MacDaniels was well qualified and successful in working with other fire protection agencies. E. T. Allen of the Station's Advisory Committee assisted in establishing a favorable climate of cooperation.

By the year end, Shepard commenced preparation of preliminary reports on climatic phases of the fire insurance study. Considerable interest in the techniques and results of this pioneer study developed among fire protection and insurance agencies operating in other fields of insurable property subject to fire loss.

The Station's going-fire study program under McArdle's direction was gaining strength and diversification with employment of additional seasonal employees and cooperation of National Forest Administration. A principal objective was to bring to conclusion the study of the time factor in fire control (better known as hour control) or speed of attack. Study of the effective range of visibility from lookouts was commenced in cooperation with the Regional Office and initially consisted of testing various types of material for creating artificial smoke. McArdle and a field assistant, Theodore Coile,[25] made intensive field tests in central Oregon of the climatic and physical factors influencing visual detection of smoke.

The Station's first laboratory, if it could be so dignified, as established by rental of a small building in southeast Portland and renovating it and installing equipment. This was also used to house computing assistants working on the speed of attack project. The lightning storm study charts were stored there and William G. Morris, a former student assistant recently given junior forester permanent status, tabulated and reconciled this information for use in the reporting stage of this project. The laboratory was also used for calibration of fuel moisture sticks and adjustment of static meters. The laboratory building was shared with the newly organized forest insect group. June 1, 1931, A. G. Simson, a charter member of the Station staff, transferred to the Regional Office in Portland as a scientific aid to take charge of the Region's study of portable radio equipment and communication work. However, the static lightning studies which Simson had conducted were continued in cooperation with the physics department of Reed College in Portland. Dr. Marcus O'Day of that institution became greatly interested in the scientific application of physics to forest fire problems and several of his students were later employed as assistants on a temporary basis.

Effective April 1, 1931, the Office of Forest Products of Region 6 was transferred to the Station by agreement of Director Munger and Regional Forester Buck. In principal, this action should have taken place sooner, since the Branch of Research was established in 1915 in separation from National Forest Administration and the Station was established as a regional research entity in 1924. A number of reasons probably accounted for the lag in taking action prior to 1928 when the Sweeney-McNary Act became law. Appropriation language was not specific in reference to allotment and administration of research funds at that time. The Forest Service was not fully settled down in organization channels in the field and the big thrust was to bring the National Forests under effective protection and management promptly, using all available resources and personnel. After 1928, personnel placement problems and the inherent bureaucratic tendency to resist reduction in force hindered the transfer. The latter part of April, W. H. Gibbons, chief of the Products Office, was transferred to the Branch of Research in the Washington Office, and the remaining members of the staff, A. H. Hodgson, H. M. Johnson, Howard Spelman,[26] and Elmer Rapraeger and two clerks [27] were transferred to the Station rolls and headquartered in the Lewis Building with the Station staff and the forest insect group.

The forest products projects were continued without change or serious interruption immediately following the transfer. The survey of sawmill waste under Hodgson, in the final stages of report writing, was completed the last of June and published serially in The Timberman, beginning with the July 1931 issue and ending with the October 1931 issue. Hodgson returned to the Region 6 office of Personnel Management as training officer on July 1.

25 Later, a leading student and teacher of advanced forest soil technology. He served on the faculty of Duke University for many years.

26 At the time, Howard Spelman was on sick leave. He died January 26, 1932

27 One of the two was Christina McPhail, senior clerk-stenographer; she served as chief clerk of several divisions until retirement in 1965, except for 1 year in the Women's Army Corps during World War II. Emma Johnson resigned in 1932, but rejoined the Station staff in 1946 as chief clerk of the Forest Economics Division, retiring in 1961.

Johnson continued to carry on the census of lumber, lath, and shingle production and the minor products group of studies, and at the end of the year completed a manuscript on the "Production and Consumption of Minor Timber Products in Oregon and Washington." In the following years, this manuscript served as a source for a number of articles on varying aspects of this subject.

Rapraeger carried on the study of felling and bucking in the Douglas-fir region, which was commenced by Spelman. During the summer, he added more information on breakage losses by gathering measurements in the field on 1,100 Douglas-fir and western hemlock trees. Trees as large as 120 inches in diameter were measured. The weight of one large tree was calculated at over 100 tons of wood and bark. The impact of such ponderous trees when they are felled is tremendous and the breakage is severe if extreme caution is not exercised by the fallers in choosing the direction of fall and the bed. Much of the breakage in dense stands and rough topography is unavoidable. Computations of this study were completed during 1932 and the findings were reported in the September 1932 issue of The Timberman under the title, "Tree Breakage and Felling in the Douglas-fir Region," under E. F. Rapraeger's authorship.

The felling and bucking data were used in several other Station projects. Meyer used several hundred of individual tree measurements in the new standard Douglas-fir volume tables he was preparing. The forest survey and the Brandstrom selective logging study also used the information on breakage.

The forest products program of studies had been reviewed by the Region 6 Investigative Council and the Forest Research Council from the time these advisory bodies were organized, assuring coordination and ready integration with other of the Station's research programs. Dr. J. Elton Lodewick joined the Station staff on August 31, 1931, to head the products studies. En route to Portland from Virginia,[28] Lodewick spent 10 days at the Forest Products Laboratory in Madison, Wis., becoming familiar with their current program of research.

Rapraeger and Johnson prepared reports on yellow pine mill-scale studies conducted at the Shevlin-Hixon Lumber Co. sawmill in Bend and the Mount Emily Lumber Co. mill in LaGrande, Oreg., in cooperation with the two companies. Results of the studies were furnished to the cooperating agencies which included the Region 6 Office of Forest Management.

Periodic plot examination and remeasurement and preparation of progress reports for the methods of cutting in western yellow pine and regional races of western yellow pine studies was a major activity and, although not producing publications, was yielding much useful incidental information. For example, animal damage in western yellow pine plantations by rodents and rabbits was discovered to be the cause of severe loss leading to interest in methods of abatement.

Munger and Westveld's "Slash Disposal in the Western Yellow Pine Forests of Oregon and Washington," U.S.D.A. Technical Bulletin 259, was published December 1931.

Extensive revision of the Capper Report occupied the time of a number of Station personnel and brought many other Forest Service members to Portland for conferences during 1931. W. H. Gibbons directed the compilation of the basic forest information in his new Washington Office position and spent several weeks in Portland reviewing plans for local people working on the project. Munger, Andrews, and Cowlin gave considerable time to the timber inventory; Meyer, to forest growth; and Johnson, on timber drain from cutting. Keen and Lachmund provided information on insect and disease losses. A conference to discuss means of attaining consistency in forest growth calculations was held in September at the Station in Portland. Attendants in addition to Munger and Meyer were R. H. Weidman and Lyle F. Watts from the Northern Rocky Mountain Station; Duncan Dunning from the California Station; C. L. Forsling from the Intermountain Station; and E. N. Munns, F. X. Schumacher, and W. H. Gibbons from the Washington Office.

28 Prior to joining the Station, Dr. Lodewick was on the faculty of Virginia Polytechnic Institute in Clarksburg, Va.

Granger was with the forest survey staff most of July and part of August reviewing the results of the Lewis County comparison of methods, National Forest inventories, and the plans for the growth and depletion phase of the survey. With Andrews, Girard, and Matthews, he spent a week in the field on the Umpqua National Forest. The object of this trip was to devise and test a technique for checking the type maps and timber volume estimates to assure a reasonable degree of accuracy. Later in the year and in 1932, Girard and crews of the Station's timber experts (check cruisers) applied the technique to all the National Forests in the Douglas-fir region. Melvin Bradner of the Northern Rocky Mountain Station came to Portland near the end of July to review all phases of the forest survey with Granger and members of the local forest survey. The forest survey of the Northern Rocky Mountain region was to be initiated soon under Bradner's direction, and the plan was to use essentially the same methods that were being used in the Pacific Northwest. Bradner and Granger also made a field trip to join Kemp who was type mapping Tillamook County, Oreg., and see firsthand the techniques employed.

Early in August, Assistant Chief Clapp came to Portland and participated in the final review of the Lewis County test and decision to continue using the compilation method of forest surveys. Clapp and Granger, with Munger, Andrews, and others of the forest survey staff, tested the "stocked quadrat" method,[29] adopted by the survey, of judging degree of reproduction stocking of cutover lands and deforested burns on a nearby logged-over area.

Clapp also devoted part of his time in the Pacific Northwest with Munger, Brandstrom, and Kirkland reviewing work on the selective logging study. He visited the proposed Wind River Experimental Forest, which was in the final stages of boundary selection and submission for approval of the Chief Forester. The Pringle Falls Experimental Forest on the Deschutes National Forest in central Oregon was approved by the Chief Forester for establishment June 1, 1931. A headquarters building, costing some $450, was constructed. About the same time, the Metolius Natural Area, representative of mature western yellow pine type, also located on the Deschutes National Forest, was formally approved by the Chief Forester. These actions were the beginning in the Pacific Northwest of the maturing of the concept of controlled experimentation in forest management and demonstration of the application of forest research results to actual field conditions which was initiated by Zon nearly a quarter of a century earlier and advanced by Clapp in 1915.

At the annual meeting of the Forest Research Council chaired by Dean Peavy, who succeeded C. S. Chapman in 1929, another area of forest research was brought under the aegis of the committee. For several years, attention of foresters had been attracted to losses of conifer seedlings and saplings caused by small animals; speculation had been voiced regarding the effect of seed-eating birds and rodents upon available seed crops. Ira Gabrielson, regional head of the Biological Survey office in Portland, was asked to join the group. He discussed these problems in detail and told of the life habits and current methods for control of these forest "pests."[30] By resolution, the council requested the Biological Survey to detail a biologist to the Pacific Northwest to do research in forestry.

At this meeting of the council, a proposed program of forest and range erosion and streamflow research was presented by Director Munger which could be activated if funds were available.

Members of the council called attention of the group to the alarming appearance of hemlock looper damage to the coastal hemlock-spruce forests. The committee by resolution asked for increased appropriations in forest insect research and control measures.

29 This method was first developed by I. T. Haig and refined by the forest survey. It was used extensively in this and other western forest regions for forest surveys of all kinds.

30 Later, Dr. Gabrielson became national chief of the Biological Survey, a leading advocate of conservation of wildlife and an authority on many aspects of ecological and environmental problems.

The increasing scope and intensity of the Station's study programs directed attention to the need for improved supporting facilities. Better quarters were in prospect, as the Station had been allotted space in the new Federal Courthouse which was scheduled for completion early in 1933. The Station had an opportunity to participate in the planning of this structure and some suggestions for room arrangement, including a laboratory and a large conference room, were adopted by the architects.

The Department of Agriculture library in Portland was housed in the same building with the Regional Office, a minor inconvenience for the Station staff. A greater problem was the lack of scientific literature in this library needed by Research. Material could be requisitioned on a loan basis from Washington, D.C., or from Berkeley. However, this was a slow and tedious process. Libraries of the forest schools of the Pacific Northwest were in comparatively early stages of development during this period, particularly for the references needed for scientific research, and at considerable distance from Portland.

Miss Frances Elliott transferred from the Bureau of Public Roads as junior clerk-stenographer December 1, 1931, to fill a vacancy on the forest survey staff. Miss Elliott, a niece of Oregon's State Forester Frank Elliott, had also been secretary to Jack Kimball, Klamath Forest Protective Association, and secretary to H. D. Langille, forest engineer consultant in Portland. In view of her experience in forestry work, she was placed in charge of the Station's library in addition to her other duties on January 2, 1932. Prior to this time, the library had been maintained in the Director's office, a location which had some disadvantages. It consisted of a few shelves and the Director could see who was using the library and what they were reading, except during his absences. With the Station's growth and increased demand for reference material, need for a more formal arrangement was apparent. A small room was set aside for the library and a library committee was appointed, consisting of McArdle, chairman, Lodewick, Meyer, and Cowlin, which was authorized to supervise the filing, acquisition, and use of the library. Funds were a problem, however, and a major effort of the committee was to gain approval of an annual allotment for subscriptions and acquisition of needed literature.

A sharp increase in property tax delinquency of forest lands, principally recently cutover lands and lands supporting precommercial stands, was a manifestation of the Depression. A new project to study the nature and extent of this serious economic problem was initiated early in 1932. Sinclair A. Wilson was appointed to the Station staff on March 1 to head this project, named the "new public domain" study. The first work was done in selected counties of the Douglas-fir region where problems appeared most acute.

Fieldwork on the forest survey of the Douglas-fir region neared completion in 1932. The inventory of the National Forest lands was completed during the year and Matthews was transferred to the Station's fire research project. A type map of the Rainier National Park was made by Frank Brockman of the National Park Service, based on fieldwork done the previous year. An estimate of the sawtimber volume of the park was made by Girard during an extensive reconnaissance in the summer of 1931. Although the park and certain other lands, such as the national monuments, were reserved and not subject to commercial cutting, they were included in the forest survey to present complete coverage of the forest resources. Forest resource information on the reserved lands was so designated in forest survey public reports and maps.

Base maps on a quarter-inch-to-the-mile scale were completed for the western halves of Oregon and Washington. Each individual map covered a quarter of a State in order to keep the map to a convenient size for use on table or wall. The compilation and tracings were done by the Region 6 office of Maps and Surveys[31] with the help of many outside agencies and people, including financial cooperation of the States of Oregon and Washington and Region 6 of the Forest Service. Lewis A. (Tam) McArthur, vice president of the Pacific Power & Light Co., Portland, Oreg., gave generously of his time, and carefully checked for accuracy the cartography of each map before the final tracing. "Tam" McArthur was an authority on Northwest geography and author of "Oregon Geographic Names" and many articles on this subject. His knowledge was encyclopedic.

31 Victor H. Flach, in charge of this office, was a major factor in the success of this project.

The completed tracings were sent to Washington, D. C., for lithography in 1932. Although the maps were made primarily as a vehicle for superimposition of forest type delineation by color, they were useful simply as base maps. Nothing of this sort was previously available. Accordingly, an edition of the maps with geographic features in black and blue ink was ordered for public distribution. The half-inch-to-the-mile, hand-colored county maps which the Station was making were in demand. These were made available in blue-line prints to users for duplication and hand-coloring at their own expense. The many requests for these maps confirmed the Station's decision to make type mapping a required part of the forest survey methodology. It also gave the Station a measure of the prospective demand for the final quarter-inch-to-the-mile, colored, lithographed type maps of the two States.

March 10, 1932, the U.S. Senate agreed to Senate Resolution 175, introduced by Senator Royal S. Copeland of New York, which authorized and directed the Secretary of Agriculture to make a comprehensive report on the Nation's forest resources and attendant problems. The Forest Service had been anticipating this action and work had been underway in revising timber volume estimates and other resource data for a year or more. Passage of the resolution quickened this work. In the Pacific Northwest, compilation of the forest survey inventory data had been completed for some areas in the Douglas-fir region which were useful in adjusting previous estimates of timber volume and forestland areas and condition. Other Station projects contributed valuable data. Munger, Meyer, Wilson, Brandstrom, and Cowlin devoted much time in late summer assembling data for the "Copeland" study. In September 1932, Brandstrom went to Madison, Wis., to collaborate with Kirkland on preparation and report writing on the subject of private forestry for inclusion in the report. Director Munger left October 1 for Washington, D.C., to stay until mid-December on other phases of the Copeland study.

Matthews' first assignment in his new position was the completion of the fire depletion phase of the forest survey of the Douglas-fir region. This work was closely interrelated with the fire damage studies and the forest fire insurance project. The latter study was in a finishing stage and was awaiting availability of the forest survey inventory totals for the preparation of the final report for the Douglas-fir region. At the same time, Shepard was completing plans for extending the insurance study to the pine region of eastern Oregon and Washington. Fieldwork there was commenced in early summer and extended through most of the fall.

Early in 1932, a conference was held in Portland on the "requirements" phase of the forest survey, directed by F. J. Hallauer of the Washington Office who was conducting this work on a national basis. The purpose of the requirements phase was "to determine the present consumption and the probable future trends in requirements for timber and other forest products." A study of such a scope and character did not lend itself to separate regional studies, and the task of the various regional forest survey groups was to determine and provide information on relevant local practices and conditions for integration and analysis at the national level. Attendants at the conference included Melvin Bradner of Northern Rocky Mountain Station and Carey Hill of the California Station in addition to local Forest Survey and Products men. Following the conference, Lodewick spent a good part of the year in analyzing past consumption of lumber for single-family dwellings and garages in the Pacific Northwest. He learned that a revamping of the working plan and field procedures for the sake of simplicity was needed before extending the study to other uses of wood products and commencing similar studies in other parts of the country.

Rapraeger commenced a study of truck logging a natural companion of the developing practice of tractor logging. This gave greater flexibility to logging operations and marked the beginning of notable changes in the organization of the timber industry. By the year end, Rapraeger had gathered enough data to prepare a report on this subject. This development appeared to fit the practice of selective logging which Brandstrom was studying in the Douglas-fir region.

Cubic-foot measurement of logs was another subject about which Rapraeger studied in depth and published two reports; one advocating the use of the cubic foot for measuring pulp logs and the other, aptly named the "Iniquitous Board Foot,"[32] exposed the vagaries and deficiencies of board-foot measurement of round timber products. This proved to be an early and single chapter in a continued effort to evolve a more orderly and equitable method of measuring the quantity and quality of logs. The program of mill-scale studies was extended to the Douglas-fir sawmills in 1932, another contribution to the preceding objective.

"Utilization of Bigleaf Maple of the Pacific Northwest," U.S.D.A. Circular 225, by H. M. Johnson, was published and distributed in 1932, keeping alive the attempts to increase the utilization of hardwoods in the Pacific Northwest.

Meyer's work of previous years in forest mensuration produced several completed studies. A report on "Growth in Selectively Cut Ponderosa Pine Forests in the Pacific Northwest" was submitted for publication. [33] This piece of research was the first scientific growth and yield study made of an uneven-aged forest type in this country. The success of the study was the result of the conception and development by Meyer of a new technique for such situations. Also in 1932, Meyer completed and published in mimeograph form (to achieve prompt release) a complete set of cubic-foot and board-foot interregional volume tables for Douglas-fir. Meyer spent the month of January in the Washington Office of forest measurements in order to use data from 7,000 sample trees, taken over the entire range of this important westernwide conifer.

Accumulation of repeated measurements and observations by Isaac on natural reproduction of Douglas-fir on cutover lands and deforested burns began to direct attention to further lines of research. One obvious need was a quantitative measure of the effect of slash burning upon the forest soil and litter. Cooperative arrangements were made with Washington State College to make controlled burning of sample areas with soil analyses before and after.

In October 1932, the Chief Forester approved the establishment of the Wind River Experimental Forest in two divisions; Trout Creek, comprising 6,500 acres[34] and Panther Creek, of 3,500 acres[34], for a total of approximately 10,000 acres. It contained stands of old-growth Douglas-fir and western hemlock, advanced second growth (110 years old in 1932), pure Douglas-fir, and some 23,500 acres of burned-over land in various stages of restocking. The year 1932 was also the 20th anniversary of the Wind River Arboretum and, marking the occasion, Munger and Kolbe compiled and published in mimeographed form a report on the history and observations made of the 108 conifers and 39 species of broadleaf trees planted in the Arboretum.

Application of stand data from studies in western yellow pine of growth and yield to information on grade recovery at the sawmill gathered in mill-scale studies and cost of logging of some of the methods-of-cutting plots permitted economic analysis of several intensities of stand removal. This formed a beginning basis for determination of optimum sustained yield management of pine forests regardless of ownership.

The Station did not have a program of range management research at this time. However, in cooperation with the Regional Office, studies in effect of grazing on pine reproduction were initiated at Pringle Falls on fenced and unfenced plots.

Forest insect activity in the pine region was high. In 1931, bark beetle damage was estimated to total more than a billion board feet. Fortunately, a severe winter brought extremely high subcortical temperatures, which killed a large percentage of the wintering broods and checked the epidemic in Oregon. For over 10 years, forest entomologists had been investigating the relation of bark beetle epidemics and climatic factors and fluctuations. The

32 Published in the March 1932 issue of The Timberman.

33 Published in 1934 as U.S.D.A. Technical Bulletin 407. At this time, editing and review was handled in the Washington Office. This fact and delays in the Government Printing Office accounted for the lag.

34 Included some 1,200 acres in the previously established natural area.

permanent sample plot remeasurements furnished the opportunity to correlate beetle activity with climatic and silvicultural factors. Administrative personnel were given responsibility for measurement of plots on National Forest lands.

The hemlock looper subsided following the aeroplane dusting project of 1931. Natural causes checked the epidemic in other areas. Study of the infested stands continued to gain further knowledge of the life history, parasitism, and environmental factors of this insect and its epidemiology.

Thomas S. Buchanan, who was appointed to the permanent rolls in 1935 after working seasonally since 1928, was a graduate of the University of Idaho. Thomas W. Childs, another Oregon Agricultural College graduate, received a permanent appointment in 1929 and spent his entire professional career in the Pacific Northwest, interrupted only by graduate work and military service. John R. Hansborough[35] was detailed by Dr. Metcalf to the Portland office during 1930 and 1931 to acquire experience in western forest disease problems. After this he returned to the Northeast forest pathology office in New Haven, Conn.

Lachmund, who succeeded Dr. Boyce in 1928 in charge of the Forest Pathology Office, concentrated major research efforts of the office on the blister rust study program. He brought together a group of young men, nearly all forestry students at Oregon Agricultural College, who worked summers and intermittently during their academic work as undergraduate and graduate students. Lachmund made a comprehensive problem analysis and directed efforts toward critical study of behavior of white pine blister rust on western species as contrasted to behavior in eastern forests where research had been underway for a number of years. The group included James L. Mielke, who was appointed to permanent status in 1926, and James W. Kimmey, who worked on a temporary basis until 1932 when he was given permanent status after receiving a master's degree at Oregon Agricultural College.

This group of forest pathologists with a number of field assistants conducted field research on white pine blister rust not only in the Pacific Northwest States but extended their investigations to Idaho and British Columbia. The blister rust control program, covering Oregon, Washington, and Idaho, was headquartered in Spokane, Wash., and became a source of employment for many forest students and some graduates. Job opportunities in the private sector of the entire economy were practically nonexistent and in the Pacific Northwest the timber industry, normally an employer of seasonal workers such as college students, was laying off older, more experienced men. New openings in the regular work force of the public forest agencies were scarce. Emergency programs, some fortuitous, such as blister rust control and others planned in a Government drive to alleviate unemployment, were a brighter "side of the coin" at this time.

The election in November 1932 of Franklin D. Roosevelt to succeed President Hoover precipitated a new era in national forestry programs of many kinds, research included, although the major effort was directed to measures that would immediately stimulate the economy. Legislative action commenced soon after President Roosevelt was inaugurated in 1933.

Two unrelated and disparate events occurred in the summer of 1933 which were significant in the Station's history. In June, the Station moved to long anticipated and commodious quarters in the recently completed Federal Courthouse. In August, a sudden catastrophic fire destroyed large areas of old-growth timber in Tillamook County, Oregon, about an hour's drive from Portland. It attracted national attention and, although there was no loss of life, it is ranked as one of the record conflagrations in the Nation's forest fire history. It had an immediate impact on several of the Station's research projects and, probably more important, it was destined to have a major continuing influence on the development and strength of the State of Oregon's forest policy and its implementation.

35 Dr. Hansborough succeeded Dr. Lee M. Hutchins as Chief, Division of Forest Disease Research, in the Washington Office of the Forest Service and held this position until he retired in 1967.

Overall, the Tillamook Burn killed an estimated 10 billion board feet of high-quality timber, covering more than a quarter million acres virtually in Portland's "forest backyard." It called attention to the necessity for stepping up forest fire research.

The Station's entire fire research group and some forest survey personnel moved in on the fire. Some were working with suppression crews scouting the fire perimeters. The fire researchers were studying the factors which resulted in the abnormal rate of spread which characterized this conflagration.

This fire illuminated the importance of knowing daily and seasonal changes in the inflammability of forest fuels and accurate forecasts of hazardous fire weather. The Station had been building a store of information on these subjects for years. Some publications had resulted, but of equal or greater importance was the passing of the results of research to administrative fire control groups, public and private, by McArdle and others of the staff, at meetings and conferences. For example, the Weather Bureau was provided a summary of the data from the Station's analysis of the behavior and occurrence of lightning fires as a tool for making special forecasts of unusual danger from this causal factor.

Shepard had expanded the forest fire insurance study to cover the ponderosa pine region[36] of Oregon, Washington, and Idaho; the sugar pine *(Pinus lambertiana)* region of southern Oregon and California; and the redwood *(Sequoia sempervirens)* region of California; as well as the area of original investigation, the Douglas-fir region. Shepard was initiating the study of the sugar pine region when the Tillamook fire became an upsetting factor in hazard rating. He had to increase loss ratios to provide for such contingencies, which demonstrated that regardless of improved organized fire protection and suppression catastrophe losses could occur. Undoubtedly, this disastrous fire would cause insuring agencies to take a hard look at promoting forest fire insurance with reasonable premium rates.

Effective January 30, a section of silviculture was created to better coordinate and supervise studies in fire, forestation, natural reproduction, management, forest influences, and phenology. McArdle was made chief of the new section; other members were Matthews, Isaac, Kolbe, and Morris. This was another step in organizing the Station into functional sections. Companion sections were Forest Survey and Forest Products. The organization was still incomplete, as the economic projects of selective logging, forest fire insurance, and abandoned lands (new public domain) still operated independently with the project leaders reporting directly to Munger, as did Meyer for mensuration studies.

The physical move to the Station's new quarters took place the end of June. Much of the moving of smaller items of furniture, scientific equipment, books, etc., was done by men of the Station using panel sedans—a vehicle with a front seat and an enclosed back with an end door—which constituted most of the fleet of Station vehicles. Moving was done at night and over a weekend. It could be described as an economy move without fear of contradiction. The largest item to be moved was the temperature and moisture control kiln, which was taken from the rented small building partly knocked down and set up again in the laboratory room in the new building.

The fiscal situation was a "mixed bag" in 1933. Effective April 1, salaries of all regular Federal employees were reduced 15 percent. This salary cut was restored in three equal installments on March 16 and July 1, 1934, and April 1, 1935. and the savings impounded. To make matters worse, allotment of regular appropriated funds was reduced with the net effect that at that end of fiscal year 1934, the Station received about $51,500, or 60 percent less than the previous fiscal year. It was necessary to terminate all temporary employees and practice strict

36 About this time, the common name of ponderosa pine was adopted, replacing western yellow pine in referring to the species *Pinus ponderosa.* One reason for this change in name was to avoid confusion with the Southern yellow pines in the market place. In California and parts of southern Oregon, ponderosa pine for many years had been marketed under the name "California white pine." About 1928, the Federal Trade Commission brought a "cease and desist" suit against the California White and Sugar Pine Association. The Association appealed; on January 16, 1934, the Supreme Court upheld the Trade Commission order.

economies in travel, supplies, etc. The fiscal situation changed suddenly with the enactment of legislation providing funds for civil work programs to give jobs to the jobless and to prime the pump for recovery of the private sector of the economy.

President Roosevelt's interest in conservation of the country's natural resources directed a substantial part of these measures to forestry programs on public lands including research. This was also the "year of the alphabet," and appellations attached to the various programs and acts were commonly shortened to key letters.

The ECW[37] legislation and programs were first, and in May 1933 funds were made available indirectly to the Station under this authority. The CCC[38] camps and personnel were a part of this general program. Three men, all experienced foresters,[39] were made ECW foremen and assigned to work under C.W. Kline's supervision to make detailed topographic maps and timber volume estimates of the Wind River and Pringle Falls Experimental Forests. Crews of CCC enrollees[40] from nearby camps were assigned to assist these three men, later increased to six. The Wind River project was practically completed, but the Pringle Falls project languished because the local CCC camp was discontinued. However, basic land survey was completed, facilitating later mapping and timber estimating work.

Later in the year, direct allotment of ECW funds was made to the Station, permitting the reemployment of temporary workers laid off and the employment of additional temporary field assistants and scientific aides who assisted in the large volume of computational work that had accumulated on the forest survey, other forest economic projects, fire and silvicultural projects, and mensuration studies.

In October and November, funds and people were made available to the Station under additional Federal legislation supplementing the ECW Act. These were known as Impnira[41] and CWA[42] funds. This greatly bolstered all research activities of the Station, although it created many additional administrative problems, including budgetary accounting and personnel management. June Wertz and the capable regular clerical force coped with the problem, freeing professional people to carry on research with a minimum of disruption.

The NIRA funds were principally used to finance the forest survey and skilled people could be selected. However, some anomalous and difficult personnel situations developed. For example, six former field assist-ants were reemployed as NIRA technicians, qualified as junior foresters. Under regulations imposed by the NRA administration, their pay scale was fixed at $2,600 per annum. At the same time, junior foresters under regular appointment, including some with more than 4 years of service, were still being paid $2,000 per annum, the entrance salary less the 15-percent cut. Naturally, there were gripes mixed with bewilderment at the ways of bureaucracy, but the work went on and the quality of research did not suffer.

Progress on the forest survey speeded up with the additional field and office staff. Fieldwork on the Douglas-fir region inventory was completed. The working plan for the inventory of the ponderosa pine region was revised and tested in the field early in 1933. In this region, the same man was responsible for the work on all lands in a county, regardless of ownership. There were no separate crews for the National Forests. By midsummer, work was well started in central Oregon.

37 Emergency Civil Works; authorized by the Unemployment Relief Act of March 31, 1933.

38 Civilian Conservation Corps, also authorized by the above Act.

39 W. E. Griffee, C. V. Zaayer, and Lloyd H. De Groote. Later, Griffee and Zaayer joined the staff of the Western Pine Association. Bill Griffee became its secretary-manager in 1959 and remained in that post until the Western Wood Products Association was formed through consolidation with the West Coast Lumbermen's Association.

40 Occasionally, forest school students were located among enrollees. Other enrollees developed an interest in forestry from work in the Corps and later studied forestry at the college level.

41 The National Recovery Act (NRA, the Blue Eagle Act) of June 16, 1933. The administering body was the National Industrial Recovery Agency, NIRA.

42 The Civil Works Administration.

Compilation of the basic inventory data for the Douglas-fir region was completed and preparation of statistical reports commenced. A supply of the 1/4-inch-to-the-mile lithograph base maps was received and distributed to cooperators. The hand-colored generalized 1/2-inch-to-the-mile type maps covering each of the 38 counties in the Douglas-fir region were proving useful to many agencies. Interest in land use planning was developing at State and local government levels. Requests were being received for special compilation of forest resource information in analyzing justification for public works programs such as river and harbor improvements.

The National Recovery Act, NRA, provided for establishment of industrial codes of self-government administered by authorities under Federal supervision. The Lumber Code Authority was established in August 1933 after a series of public hearings. The principal features of the Code were provisions for control of wages and hours, production, prices, trade practices, and forest conservation. President Roosevelt personally reviewed the Code, giving special attention to the forest conservation section which became known as Article X of the Lumber Code, “Conservation and Sustained Production of Forest Resources.” The Authority was the governing body for administering and enforcing provisions of the Code. The Authority was vested with legislative and judicial powers.

Under Article X, forest practice rules were to be formulated on a regional basis after conferences between public and private representatives. Director Munger, McArdle, Isaac, Kolbe, and others of the Station participated in these conferences, extending over a year or so, concerning the Douglas-fir and ponderosa pine regions of Oregon and Washington. It was gratifying for the research agencies to be called upon in such a critical and important action program. Subjects covered by the Article X rules were forest regeneration; seed supply; slash disposal; protection measures against fire, insects, and disease; economic selective logging; and sustained yield forest management. Some people credit these events with initiating the rapid development of industrial forestry here during the recovery period commencing in 1938 or 1939.

Brandstrom presented the results and recommendations of his selective logging study in the Douglas-fir regionto a large number of timbermen in a series of eight roundtable seminars. His report, “Analysis of Logging Methods and Operating Methods in the Douglas-fir Region,” was published jointly by the Charles Lathrop Pack Foundation and the West Coast Lumbermen’s Association June 1933.

Munger, Rapraeger, and Kolbe analyzed in considerable detail financial aspects of various methods of cutting under sustained yield management of public-owned ponderosa pine forests.

Meyer had an unusually busy year in 1933, starting a growth and yield study of Sitka spruce-western hemlock stands in the coastal fog belt and extending the growth and yield study of ponderosa pine to even-aged stands. The spruce-hemlock study was also made in even-aged stands; later, it was planned to cover uneven-aged stands of these species. In preparation for these studies, Meyer constructed a set of western hemlock and Sitka spruce volume tables.

Near the end of the year, some 50 people, men and women, were added to the Station work force through the CWA. Many of these people were college graduates; engineers, architects, and liberal arts students. Several of the women were talented graphic artists. They worked on many of the Station projects as draftsmen, computers, and clerks and materially aided their progress. The Station’s quarters were inadequate to accommodate such an influx. The Station’s conference room became a drafting room; the laboratory housed some; regular staff doubled up; but it was necessary to find more space. Fortunately, the Circuit Court of Appeals in the same building had two large jury rooms which were not being used and were loaned to the Station, giving space for a dozen CWA workers. Unfortunately, one worker, after the rooms had been used for some time, marred an oak desk by leaving a burning cigarette on it. Inspection of the rooms by Judge Bert Haney of the Circuit Court, which was headquartered in San Francisco but met periodically in Portland, discovered this blemish. It was the author of this history who had to appear in camera and received a decision from the judge that we were poor tenants and would have to vacate the rooms. The historian did not have benefit of counsel and the Station did not appeal.

The Copeland Report was transmitted to the Senate March 27, 1933, under the title, “A National Plan for American Forestry,” and published as Senate Document 12, 73rd Congress, 1st Session, in two volumes, 1677 pages.

Obviously, a report of this magnitude was the work of many authors. There is little doubt, however, that Assistant Chief Earle Clapp read the entire report in manuscript. The Station not only contributed data and ideas to the report, but Director Munger was listed as the author of two chapters; one named “Breakdown of Private Forest Land Ownership—Tax delinquency, reversion to counties, and land abandonment,” the other entitled “A Program for Intensive Forest Management.”

B. P. Kirkland, at this time on the Washington Office staff, wrote “Status and Opportunities for Private Foresty,” drawing much of his material from Station studies.

October 23, 1933, Chief Forester Robert Y. Stuart died as the result of an accident. He was succeeded by Ferdinand A. Silcox who was reported to be the personal choice of President Franklin D. Roosevelt. In 1908, when headquarters of District 1 of the Forest Service was established in Missoula, W. B. Greeley was District Forester, assisted by Ferdinand A. Silcox. Richard H. Rutledge was assistant district forester in charge of operation assisted by Robert Y. Stuart. Albert W. Cooper was assistant district forester in charge of silviculture assisted by David T. Mason. It is noteworthy that three of these men became chief foresters of the Forest Service; Greeley, Stuart, and Silcox. Rutledge became head of the Grazing Service in the Department of the Interior. Mason had a notable career in forestry education, private forestry, and association work. Cooper later became secretary-manager of the Western Pine Manufacturing Association based in Portland, Oreg.

Silcox left the Forest Service some years later and was engaged in labor relations work in New York at the time of his appointment as Chief Forester.

Fiscal arrangements continued to be an important factor in conducting an orderly and balanced research program at the Station during 1934. Administration of the emergency funds was becoming more complex with frequent changes in rules and regulations concerning use of the funds and personnel employable under the several programs. June Wertz became very competent in the intricacies of the financial situation and successfully kept the Station financing and budgetary records in order. The CWA program was terminated April 26, 1934; however, April 1 an ECW allotment of funds to the Station permitted transfer of most of the people to ECW financing.

Some research programs were better adapted by nature of the work to use emergency money and people than others, although in the long run, all or nearly all of the Station’s active studies received some benefits. The forest survey in particular and the other economic programs to considerable extent profited by the emergency work funds and people. Andrews, an able administrator and an innovative researcher uninhibited by bureaucratic red tape, grasped the opportunity to speed the progress of the survey and enlarge the scope of its coverage in the form of reports, type maps, and special studies. He also gave the Director strong support and assistance in managing the Station’s budget problems. Others of the survey regular staff likewise had strong supervisory talents. The new public domain project and related land use planning activities were also able to use CWA crews effectively, gathering tax delinquency data at county seats and transferring the data to county maps. This work was done in cooperation with the Washington State Agricultural Experiment Stations, starting late in 1933 and continuing through the first half of 1934.

The Depression called attention to the failure of the economy to plan for rational and orderly use of natural resources; soil, water, forests, and minerals. Under the Roosevelt administration, many measures were taken and agencies formed to correct this situation. Planning councils and commissions were formed at the national, regional, and State levels, and later at the county level.

In the spring of 1934, the Pacific Northwest Regional Planning Conference was convened by the Pacific Northwest Regional Planning Commission. Planning commissions of the States of Washington, Oregon, Idaho, and Montana had been formed and were represented on the Regional Commission and participated in the conference. Munger and Andrews both addressed the conference. As the various planning bodies became organized and functioning with regular staffs, they leaned heavily upon the Station for data regarding forest resources in all of their aspects as they contribute to the economy of the Pacific Northwest. Many members of the Station staff were called upon to meet with various groups to counsel them as well as to supply specific information which often took the form of special reports. Wilson, Brandstrom, Lodewick, Andrews, and Cowlin spent many days on planning activities with the several groups.

The emergency programs supported a much needed program of physical plant improvements at Wind River and Pringle Falls Experimental Forests. Accomplishments included construction of new buildings, reconditioning of existing structures, road and fence construction, and installation of a water system at the Wind River Arboretum. Mapping and cruising of the Pringle Falls Experimental Forest was completed. At Pringle Falls a number of thinning plots in ponderosa pine and lodgepole pine stands were established and a 1,000-foot firebreak was cleared. A detailed map and cruise of a part of a proposed Blue Mountain Experimental Forest was made. This work on the experimental forests took a considerable amount of Kolbe's time and effort. Isaac was able to use a crew of CWA and ECW computers to good advantage, analyzing the mass of data accumulated on Douglas-fir natural reproduction studies. One result of current importance and application was the disclosure of extremely high mortality of single seed trees left on National Forest clearcut areas. Douglas-fir cutting practices were under intensive review and study during this period. On the other hand, the supervisory burdens delayed preparation of final reports on some silvicultural projects.

In May 1934, the Chief Forester approved the establishment of the Cascade Head Experimental Forest, containing approximately 6,500 acres of spruce-hemlock stands on the Siuslaw National Forest on the Oregon coast. Earlier in the year, CCC field crews under Kline's supervision completed mapping and an intensive cruise of the experimental forest.[43]

Foremost in discussions of the Forest Research Council meeting, held March 14, 1934, was Article X of the Lumber Code. Colonel Greeley and C. S. Chapman emphasized the need for a forest practice manual for the Douglas-fir region. Others of the council agreed but raised the question of the issuing body—should it be the Station as some suggested or the State and Federal Governments cooperatively or the Lumber Code committee? Regional Forester Buck advocated that the job be done by the Lumber Code committee. Others urged that the Station take a leading role, and all agreed that the Code Committee would have representation from the State and Federal Governments. It was finally agreed that the Station would be assigned the task of writing the introductory pages of the proposed handbook, giving the technical background for the required forest practices which would be described in the following pages. It had been agreed earlier that the handbook was to be written for use by loggers, not foresters, which set the stage for this arrangement. It is interesting to note that the forum for these discussions and decisions should be the Forest Research Council of the Pacific Northwest, which was in fact of origin the Station's Advisory Committee.

43 One of the crew leaders on this project was a junior forester, appointed early in 1935, Boyd L. Rasmussen, later Assistant Chief, U.S. Forest Service, and Director of the Bureau of Land Management. Other junior foresters appointed to the Station this year included W. H. Beeman, Roy C. Carlson, E. G. Dunford, George S. Meagher, David Judkins, Stanton Hayward, Marion Nance, Clarence W. Richen, C. H. Willison, and Harry H. Wolfe.

The previous year, 1933, Richard S. Kearns, Burnett H. Payne, and Howard Hopkins were appointed as NIRA technicians among several others. Payne had the distinction of being the first and senior member of a "father and son" team, employed by the Station when Dr. Brian R. Payne joined the staff in June 1963.

Munger, McArdle, Isaac, Kolbe, and Brandstrom were the principal contributors to the handbook, although others of the staff also added needed information. Growing interest in partial cutting of Douglas-fir forests, largely generated by Brandstrom's selective logging studies and demonstrations, demanded that this subject be included in the Article X handbook.

At this meeting of the council, Brandstrom presented the principles of economic selective logging, using as a model the Herman Creek sale area on the Umpqua National Forest in southwestern Oregon. This was a 6,000-acre unit, and he demonstrated that by use of light cuts and short cutting cycles with tractor and truck logging, costs would be appreciably lower than under current clearcutting practices. This was virtually a tree selection system taking high-value or plus trees and leaving low-value or negative-value trees. Brandstrom maintained that this system was also better adapted to sustained yield operations than clearcutting. David Mason, a council member and long a student and advocate of sustained yield practices, was a participant in these discussions. Soon after this meeting, he became administrator of the Lumber Code in the NRA Washington Office. He saw that Article X was an opening for initiation of a move to achieve sustained yield private forestry.

Regional Forester Buck was developing an interest in putting into practice selective cutting on future sales of National Forests of the Douglas-fir region. At the same time, some foresters were looking to area selection rather than tree selection as the ultimate method of cutting for most of the old-growth Douglas-fir stands.

Brandstrom and Rapraeger cooperated with the Region 6 Office of Timber Management in preparing plans for a selective logging sale on the Columbia National Forest near Wind River.

Wilson's new public domain study reached the report stage in 1934 and two separate mimeographed reports were issued.[44]

The reports were issued in this form to get prompt release of the findings. Forest taxation was a live subject and with the conclusion of the Forest Taxation Inquiry (the Fairchild study) and the adverse economic condition and other economic studies of the Station, much new information was on hand to consider ways and means of correcting problems of private forest-land ownership. Two reports were published in 1935; one a summary and the other a detailed report.[45] At the suggestion of several council members, a second special meeting of the council was called as a conference on forest taxation. In addition to council members and Forest Service representatives, the Oregon legislative Interim Committee on Forest Taxation, the Oregon State Tax Commission, the Portland Chamber of Commerce, and the Washington State Forestry Conference were represented.

The result of the conference was a resolution requesting the Secretary of Agriculture to detail one or more members of the Forest Taxation Inquiry staff to this region for several weeks to work with local agencies in considering application of various tax systems to the States of Oregon and Washington. The final goal would be improvements in forest tax legislation of the two States.

Completion of the fieldwork and computation of the forest survey inventory data cleared the decks for publication of results. There was no longer any noticeable objection to release of timber volume data by counties. Attitudes of the timber industry had changed materially, probably partly as a consequence of the existing economic conditions and partly as a realization that such basic forest resource data were needed by private and public agencies alike to plan courses of action to restore the forest-based economy of the Pacific Northwest to a healthy condition.

44 "Facts Bearing Upon Instability of Forest-Land Ownership in Western Oregon." Sept. 1930. Mimeo.

45 "The Forest Tax Problem and Its Solution Summarized," by R. C. Hall. U.S.D.A. Circular 358, 18 pp., 1935, and "Forest Taxation in the United States," by Fred R. Fairchild and Associates. Misc. Pub. 281, 681 pp., 1935.

The Copeland Report outlined a program of Federal and State Government acquisition of forest lands marginal for private ownership and management for continuous production of timber crops after describing the problems of private ownership that appeared during the Depression. Forest regulation of private forests by Federal and State Governments was discussed in a comparatively low-key chapter of the report prepared by W. N. Sparhawk, at that time a member of the Washington Office staff of the Forest Service. This issue, however, was certain to reappear, as it had in the past, in reviews of the Nation's forest resource situation and problems and in congressional proposals and deliberations.

Acting Assistant Chief Marsh[46] of the Washington Office was in Portland for several weeks and devoted a major part of his time to the forest survey. The scope of the final regional report for the Douglas-fir region was discussed in a conference with Munger, Andrews, and Cowlin. Later, Marsh and Cowlin discussed an outline of the proposed report in detail. The latter completed a draft of the introductory chapter of the report giving scope, methodology, and specifications by the summer's end. In the general conference, it was decided to present complete inventory, growth, and depletion data for each of the 11 units or regions.[47] It was also decided to issue as a Station mimeographed publication, a minireport for each of these units. Near the end of the year, when final growth and depletion data were available, Cowlin completed a draft of the report for the North Puget Sound unit.

By late summer, Johnson and Lodewick of the Products group completed the cutting depletion estimates and Matthews the fire depletion estimates, and projections of future forest depletion or drain (as some writers call it) were made. This provided the basis for Meyer to complete forest survey growth projections for the Douglas-fir region and the 11 units.

Lodewick continued to gather information for the requirements phase of the survey, expanding the work to rural and industrial usage and needs. Survey of farm needs was done in cooperation with the State colleges of agriculture.

The forest survey program of map production moved into a final stage in 1934. Half-inch-to-the-mile generalized and 1-inch-to-the-mile detailed type maps had been completed for each county in the Douglas-fir region. Arrangements had been made for making these maps available to prospective users in blue-line print form at their own expense by making vandyke negatives and lending them to commercial blueprinting companies. The Station provided a mimeographed forest type legend and instructions for coloring. Many public and private users, including a number of timber companies, took advantage of this service.

The forest survey's 48 detailed types for the Douglas-fir and ponderosa pine regions were consolidated into 25 types for presentation on the quarter-inch-to-the-mile type maps. The four western quarters of the two States included all of the Douglas-fir region and extreme western part of the ponderosa pine region. The crest of the Cascade Range forms the boundary dividing the two forest regions and is also the eastern boundary of all counties in the Douglas-fir region, except Skamania County, Washington, and Hood River and Jackson Counties, Oregon. The first two named border the Columbia River and extend a comparatively short distance east of the Cascades. Jackson County borders California on the south where the Cascade Range crest is indistinct. In this county's extreme eastern part, forest types are dominated by ponderosa pine.

Fieldwork in the portion of the ponderosa pine region appearing on maps of the west half was completed in 1934. In December of that year, George T. Wilkinson of the U.S. Geological Survey, an authority on lithography and engraving, spent 10 days in Portland with the survey staff advising on procedures in preparing maps for color

46 Earle H. Clapp was made Associate Chief of the Forest Service about this time, leaving the position of Assistant Chief in charge of Research.

47 The matter of nomenclature becomes confusing as the term "region" is popularly used in describing varying areas. That is the reason the forest survey adopted the term "units" to apply to groups of counties in the Douglas-fir region having homogeneity.

lithography. Color combinations and patterns were selected with his help and a legend was decided upon. Soon after, draftsmen started work preparing the copy which would be furnished the Geological Survey in Washington, D.C., for lithography.

Forest survey fieldwork moved ahead in the ponderosa pine region during the summer and fall. After the crews returned in November, Moravets directed half a dozen NIRA and ECW workers gathering advance data—ownership data, timber cruises, maps, and aerial photos[48]—in preparation for completing fieldwork of the inventory phase of the survey during the next field season.

R. C. Hall of the Forest Taxation Inquiry was detailed to the Station in November and December of 1934 to advise the States of Oregon and Washington in formulating forest tax programs and legislation. During his stay in Portland, he met with planning councils and other groups and in mid-December addressed the annual meeting of the Western Forestry and Conservation Association on the deferred timber tax plan.

Shepard completed the final report summarizing his studies of possibilities of forest insurance in the Douglas-fir, ponderosa pine, sugar pine, and redwood regions of Washington, Oregon, and California. This office report, completed by the year's end, contained 460 pages and was entitled "Forest Fire Insurance in the Pacific Coast States" and was transmitted to the Washington Office for review and publication.

The fire studies group devoted a major effort to designing a system of some 100 fire danger stations for establishment on the National Forests of Region 6. These stations were located to give the optimum coverage of fire weather and forest fuel conditions. Each station had a shelter housing instruments to measure wind, temperature, precipitation, and relative humidity. Hazard indicator sticks to measure fuel inflammability were also a part of the station equipment. Stations located at lookouts also had visibility meters. George M. Byram, first employed temporarily in 1932 and reemployed in 1933 and 1934, did much of the instrument adaption and design. He was a student of Dr. O'Day at Reed College. After graduation, he was employed by the Forest Service on a permanent basis. He spent many years on fire-related research at this Station and at the Southeastern Forest Experiment Station. About 25 such stations were equipped for the State and private forest fire protection agencies. Earlier work by the Station had shown that the primary lookout system should not be based on a radius of visibility exceeding 15 miles. Average distance of initial discovery, based on analysis of years of records, was found to be 9.8 miles for east-side lookouts and 7.7 miles for west-side lookouts. Discovery distance was found to be only slightly greater when one was looking toward the sun than looking away, contrary to common belief.

Hazard reduction problems arising from logging slash in selectively cut areas drew the attention of the fire researchers.

Deterioration of fire-killed timber was the subject of a cooperative study of the Station's fire and products groups and the Bureau of Plant Industry and Entomology, sparked by the 1933 Tillamook Burn. Studies were made of timber on older burns as well as the 1933 burn. These studies supplemented those by Knapp in 1909-10. Salvage was beginning to get underway on the Tillamook Burn, where loss of valuable wood from insects was becoming apparent.

Robert L. Furniss joined the Forest Entomology staff in late 1934; other members of the staff were Keen, Beal, and Buckhorn.[49] At that time, the Entomology group were establishing a series of sample plots in the pine region to evaluate trends in mortality loss from beetle attacks.

48 Wernstedt had taken aerial photos of portions of the National Forests recently and some photos were becoming available from other sources. These photos were a valuable adjunct to the field men.

49 Walter J. Buckhom joined Keen's staff as a scientific aide soon after the field office opened in Portland. Previously, he had worked on insect control projects in southern Oregon since the early 1920's. Although not a college-trained entomologist, he had many talents and contributed much to entomological research.

The Station was host to C. G. Smoot of the U.S. Bureau of Chemistry and Soils who had returned to continue studies of western hemlock bark as a source of tannin. He had used the Station previously as a Portland head-quarters for his study. The chestnut blight in the Eastern States was threatening the domestic supply of tannin extracts.

July 1934 marked the 10th anniversary of the Station. Great changes had occurred in that short period in the size and quality of the Station's research programs and facilities. Numbers of personnel had increased from six permanent employees and four field assistants in 1924 to 30 permanent employees and over 100 full-time and temporary unappointed employees[50] in 1934.

Other notable personnel actions occurred in 1934. In September, Dr. Richard E. McArdle resigned after 10 years of service to become dean of the School of Forestry at the University of Idaho, a distinct loss to the Station.

The Station library was the beneficiary by the employment of Miss Erna Jeppesen, a trained librarian, to reclassify the library according to a system sponsored by the Society of American Foresters. After 3 years under temporary appointments and emergency fund financing, she was appointed to the permanent staff in September 1937 as "under library assistant."

In August of 1934, Miss Jean Kerr, an assistant editor of the Washington Office of the Forest Service, was moved to Portland for an indefinite detail. The Station had several major publications in office report form and others in the offing. Previously, publications for printing by the Government Printing Office and certain other major publications planned for other outlets received final editing in the Washington Office. This procedure was laborious and time consuming, involving considerable exchange of correspondence or an author's trip to Washington, D.C., or occasionally both.

Changes in financing under the several emergency programs in 1935 reduced the Station's ability to use the money and personnel effectively. NIRA money in 1935 consisted only of small amounts carried forward from 1934. The constitutionality of certain provisions of several NRA codes was being tested in the Federal courts. The Lumber Code, including Article X, was developing some problems in enforcing compliance and was losing support of segments of the industry. The Supreme Court shot down the "Blue Eagle" National Industrial Recovery Act in its entirety in a decision concerning the poultry industry code, May 27, 1935 effectively abolishing all codes. The industry and public programs developed under Article X were considered successful enough to be continued under voluntary cooperative arrangements by the industry through the trade associations and the public agencies. Soon after the Western Pine Association and West Coast Lumbermen's Association organized Forest Practice Committees. About this time, the associations added foresters to their staff. Clyde Mart was appointed Chief Forester for the Pine Association soon after this time.

The NIRA-, CWA-, and ECW-funded programs were generally directed toward stimulating the economy through industrial recovery, civil works, and public works, thus providing jobs for the unemployed. These programs aided many people, but many others remained unemployed and in need of direct relief. This prompted Congress to authorize an Emergency Relief Appropriation (ERAs) to be administered by the Works Progress Administration. The Station was alloted funds to employ people certified from the public relief rolls. This changed the character of the skills of eligible people and limited the type of work which could be undertaken. In many cases, manual workers had to be employed. These people were used on improvement programs on the experimental forests. Other office workers were available in the Portland area. Some latitude was provided through authority to use 10 percent of the funds for supervision and overhead, opening the way for selection of more experienced persons for key jobs.

50 These employees were authorized and paid under the several emergency programs.

CCC crews were still available for work at the experimental forests and with the ERA crews, many improvements in the physical facilities were made. Stand improvement work and installation of fenced plots were also done by the CCC men. A 20-percent cruise of the recently established Blue Mountain Experimental Forest was made by CCC crews, which included some forest school students.

The expansion of selective cutting of Douglas-fir using truck and tractor logging resulted in a reorientation of Douglas-fir silvicultural studies from clearcut areas to those areas which had some form of partial cutting within recent years to determine silvicultural impacts from these practices. Field crews under Isaac's direction located and examined such areas systematically for status of regeneration, windthrow losses, and damage to the residual stand through logging injury. The fire research group under Matthews and Morris started a study to develop a sound method for appraisal of increase in fire hazard in the partial cutting areas. When Brandstrom's selective logging studies first started this question had been raised by members of the Station Advisory Council, particularly those most concerned with fire protection activities.

The Tillamook Burn continued to serve as a study area. Meagher, under Isaac's supervision, made a survey of seed dissemination and regeneration establishment in this important area. Morris compiled and examined all reliable material that could be found on the origin, behavior, and effects of this 1933 fire for a permanent record. The fire research group cooperated with the Regional Office in developing a fuel type mapping project and planning an "intelligence unit" for service on major fires to encompass all scouting, communication, weather, and research. The Tillamook fire exposed the need for such a plan. Snag-burning studies were conducted on a 320-acre demonstration area at Pringle Falls under controlled conditions to determine the value of the "base fire" method of burning down snags of various sizes and ages.

The forest survey completed all fieldwork in the ponderosa pine region late in 1935. In the office, work was progressing on the compilation of inventory, growth, and depletion data gathered in previous years, so that results could be released promptly. Experience in the Douglas-fir region had shown that use of this information was increasing greatly in planning activities, in programs to restore stability in the timber industry, in public works programs, and in the other Station economic studies. There was a lively interest by some midwestern and eastern financial institutions in effecting a merger of companies in the Douglas-fir region to bring financially weak companies under stronger ownership. Responsible leaders in the industry were advocating Federal Government acquisition of large blocks of old-growth Douglas-fir that were not operable under current conditions and which were a heavy burden on the owners.

From the beginning of the forest survey, industry members of the Advisory Council had suggested that the sawtimber inventory be classified or qualified in some way to show that much of it was not operable under current conditions and, in fact, a considerable portion could not be exploited commercially for many years. After the survey had been in progress for several years, the survey staff developed a classification and plan for rating inventory board-foot regional totals by three classes of economic availability. Two ownership classes were recognized. National Forest and "all other" (the great majority, private ownership), and three species groups, Douglas-fir, pulp species, and all other species. Girard assisted by Kline and Wakeman in collaboration with Bruce E. Hofmann[51] of the Regional Office, did the classifying.

In 1931 and 1932, the U.S. Corps of Engineers, War Department, made a comprehensive study of hydroelectric power in the Columbia River Basin, and analyzed potential power sites for development by the Federal Government. It was sent to the 73d Congress, 1st Session, by the Secretary of War on March 20, 1932, in a two-volume, 1845-page report entitled "Columbia River and Minor Tributaries, a plan for hydroelectric development." The report was printed by the Government Printing Office in 1933 as House Document No. 103. At this time (1935) one project, the Bonneville Dam, on the lower Columbia River not far above Portland, was under construction. This

51 Hofmann, logging engineer, Timber Management, Region 6, was detailed to the Station for several months to work on this project. He had extensive knowledge of conditions on the National Forests and other lands.

was “run-of-the-river,” relatively low-cost project, designed mainly for power generation with only minor navigation benefits and negligible flood control effects. The dam was comparatively low in height. It was the first of a number of dams to be constructed on the Columbia River system by the Federal Government, and the Bonneville Power Administration was created by Congress in 1937 to manage the marketing and distribution of electric power from this and subsequent hydroelectric projects in the Columbia Basin. The Corps of Engineers directed the construction and management of the project which was put in operation July 9, 1938. The Regional Office was requested by the Corps of Engineers to contribute to a study of the pulp and paper industry of the Pacific Northwest. In their planning, the Corps of Engineers visualized this industry as not only a consumer of electric power, but also the source through expansion, based upon timber resources, of an enlarged and more diversified economy in the Pacific Northwest. At the annual meeting of the Region 6 Investigative Committee,[52] held April 3 and 4, 1935, there was strong sentiment, expressed chiefly by Regional Office representatives, that a study should be initiated on economic potential of expanding the pulp and paper industry in this region. Lodewick of the Products group opposed such a study, contending that it was a responsibility of people in Business Administration, and that the function of the Federal forest research agencies should be that of providing data from the forest survey and the Forest Products Laboratory. B. E. Hofmann and W. J. Wakeman[53] of the Regional Office prepared a report on “The Pulpwood Resources of the Lower Columbia River” which was included in the Corps of Engineers report, “The Pulp and Paper Industry of the Pacific Northwest.” This was a more comprehensive study and the forerunner of a number of other studies of the interrelations of hydroelectric power generation and other natural resources of the Columbia Basin.

In December 1935, the Station published a mimeographed report on the pulpwood situation in the Pacific Northwest, based upon forest survey findings.[54]

Other publications during 1935 in this general information area included an article on timber resources by Briegleb and one by Kline on economic availability of saw-timber in the Douglas-fir region, both published in different issues of The Timberman, and an article by Lodewick in Pacific Pulp and Paper Industry entitled “How Much Is A Cord of Pulpwood?” The trade journals continued to be an effective medium for publication of progress reports on research projects.

Experience on the growth and yield studies, other mensurational and silvicultural studies, the mill-scale studies, and the forest survey disclosed the need for more expertise in modem techniques of statistical analysis and experimental design such as Dr. Meyer possessed. The Washington Office Branch of Research was initiating an in-Service training program at this time to fill this gap which was prevalent at the field stations. Briegleb was selected to attend the forest measurements training session held in Washington in December 1935. This anticipated the resignation of Dr. W. H. Meyer, effective January 1, 1936, to join the faculty of the College of Forestry, University of Washington. This was the beginning of a long and distinguished career by Meyer in forest education at the universities of Washington and Yale.

Another personnel change occurred in the spring[55] of 1935 when the Station receptionist and Director’s secretary, Edith A. Parmeter, resigned to be married. Frances Elliott took her place.

The 1935 meeting of the Investigative Committee was marked by a renewal of the strongly expressed need for range and wildlife studies in both the pine and fir regions. The pine region was undergoing a prolonged drought period which was aggravating range management problems. Wildlife management problems as well as grazing

52 At that time, it was called the North Pacific Forest Research Committee in the minutes prepared by the secretary, W. H. Meyer.

53 Wakeman was transferred from the Station to Region 6.

54 Pulpwood Resources of Western Oregon and Western Washington. Forest Research Notes No. 17. Mimeo. Dec. 10, 1935. H. J. Andrews, R. W. Cowlin, F. L Moravets, and W. H. Meyer.

55 Proving that in the spring a young man’s fancy turns to thoughts of love.

of cut over lands by domestic livestock were becoming more acute and noticeable in the fir region. Since only emergency financing was in prospect for the Station to recruit a qualified range research man, Regional Forester Buck volunteered to assume the financing of the project if Station funds should dry up.

In January 1936, the Charles Lathrop Pack Forestry Foundation published "Selective Timber Management in the Douglas Fir Region," by Burt P. Kirkland and Axel J. F. Brandstrom, Division of Forest Economics, Forest Service. Although no mention of the Station appears on the title page, the authors' preface, dated February 1936, Washington, D.C., states: "Since 1931, as members of the United States Forest Service, they have conducted, largely under the auspices of the Pacific Northwest Forest Experiment Station, extensive studies aimed at the practicability of selective timber management." Later in the preface, the authors acknowledge assistance of E. F. Rapraeger of the Station staff.

At the time the manuscript was being readied for final publication, senior author Kirkland was attached to the Division of Forest Economics of the Washington Office Branch of Research. Brandstrom, who contributed the major body of the material that was contained in the report, was on the Station staff.

Prior to submission to the Chief's office for final approval, the manuscript was reviewed by Munger and several others of the Station staff. Numerous objections were raised to some of the conclusions reached, and questions were raised regarding the accuracy and validity of certain supporting data. Munger and Isaac, particularly, objected to the treatment of the silvicultural aspects of the proposed timber management practices. A long and detailed memorandum specifying objections to publication of the report was sent to the Washington Office under Munger's signature. The Washington Office overruled Munger's objections to publication; however, he made a trip to Washington to present his case in person. After hours of conference, the Chief's office decided to modify the report and publish it. Brandstrom was more flexible in his position toward the silvicultural problem than Kirkland. However, the latter was in a stronger position to gain his point of view.

As the report was finally published, the authors acknowledged that there were unsolved silvicultural and fire protection problems in selective timber management of Douglas-fir forests of this region. The report also made a clear distinction between the proposed system of selective timber management and types of partial cutting, such as "economic selection logging" or "high grading." They also recognized the need for area selection, group selection, and individual tree selection in a flexible system of selective sustained yield timber management.

The report included a foreword by Chief Forester Silcox which cautions the reader that the report's proposals should be considered as a "working hypothesis" that was not yet completely tested in practice. The foreword also emphasized the preliminary character of portions of the report pointing to the need for further research to determine accuracy of some of the data presented. The essence of the Chief's foreword is that the report is "thought provoking, original, and constructive," but is not a panacea for the Douglas-fir timber industry. Despite this, some viewed the authors' proposals as the ultimate in Douglas-lfir management.

Regardless of the establishment of the Branch of Research in 1915 as a coordinate unit in the Forest Service dedicated to determination of facts through scientific inquiry and the charter given by the McSweeney-McNary Forest Research Act of 1928, the Branch of Research (including its field stations) was not totally accepted by many in the Service as independent of control by officers of the Administrative Branch in conduct of research programs and in its search for untrammeled forest facts. Pressures to subordinate Research by Administration forest officers were mounting within the Washington Office and the Regional Offices during the 1930's. Support for an expanding program of research was noticeably lacking in the Service generally, and in some instances there was outright opposition to the building of a strong Research organization. Some maintained that Research should function as a handmaiden to the Administrative Branch. For example, according to the Service "grapevine," Assistant Chief Earl W. Tinker of State and Private Forestry and his assistant, Chief of the Division of Private Forestry, Gerald D. Cook, coveted the forest survey and other economic research projects and advocated transfer of such activities to State and Private Forestry.

There was tardiness and resistance in the field to the adoption of desirable changes in management practices on the National Forests which had been documented by research findings. In some cases, this reached the point of rigidity in accepting new principles and practices. In the Pacific Northwest, Regional Forester Buck apparently was unwilling to consider that the Station was not subject to his control and orders and was showing a tendency to embark on extensive studies which could better be performed by the Research organization.

Job classification, which was handled in the field by personnel management personnel in the Regional Offices and in the Washington Office, discriminated against Research personnel under Forest Service interpretation of Civil Service rules and regulations. For example, Station Directors usually lagged behind the Regional Foresters in professional grade. This disparity extended down into the ranks. Job classification was governed by principles used for line officers and did not recognize the distinct difference in the qualifications for research. As a result, the Branch of Research was frequently raided by Administration for promising personnel and others were discouraged by slow advancement and left for other employment. An example was the transfer of Lyle F. Watts, Director of the Northern Rocky Mountain Station, to Region 9, the Lake States Region, as Regional Forester. There were other similar cases throughout the Service.

In 1935, Earle H. Clapp became Associate Chief of the Forest Service. He had fought for many years to protect the integrity of the Research Branch. He considered the situation serious enough to call it forcibly to the attention of Chief Silcox and obtain reconfirmation of the basic principles under which the Branch of Research was created. His concept was that the Branch of Research should be an elite group in the Service with a strong voice in the formulation of policies and development of procedures for administration of the National Forests and promotion of State and Private Forestry.

Dr. Meyer was generous in giving the Station the benefit of his knowledge and time despite the urgency of developing his classroom lecture program at the University of Washington. He visited frequently at the Station during the early part of 1936, advising with Briegleb concerning mensuration problems of studies nearing completion and new studies. The growth and yield study of even-aged stands of ponderosa pine was in the final stages of computation. Data of this study were already in use by the forest survey at the California Forest Experiment Station in Berkeley, Calif., as well as at this Station. Volume tables constructed by Meyer for Sitka spruce and silver fir *(Abies amabilis)* were in great demand by National Forest administrators, timber operators, timber cruisers, and forest protective organizations. Expansion of partial cutting in the Douglas-fir region had increased the need for basic information concerning the more tolerant species and those which previously had not been actively exploited. Reviewing the nearly four decades of study in these two subjects (growth and yield and methods of cutting) demonstrates the continuing need for research in quest of not only new information but also critical reassessment of fundamental data and concepts and conclusions of earlier years. It again confirms the wisdom and foresight of early forest researchers in establishing a system of permanent sample plots and the network of experimental forests.

The Port-Orford-Cedar Experimental Forest, consisting of 9,192 acres of mixed Douglas-fir and Port-Orford-cedar (*Chamaecyparis lawsoniana*) was established on the South Coquille River in southwestern Oregon in June 1936. This rounded out the complement of experimental forests covering the five major types in the Pacific Northwest. Thanks to the emergency financing, office buildings, dwellings, roads, bridges in some cases, fencing, utilities and auxiliary physical improvements had been provided for these five units. In addition, the areas had been mapped and cruised, various types of research field plots had been established, fuel hazard type maps had been made, climatic record keeping facilities installed, and sundry other study assistance given the regular research group. It was the policy at that time to man these establishments with a permanent forest management researcher, at least during the seasons that permitted outside work. This was largely the result of inadequate transportation facilities involving comparatively heavy travel costs. A closely related program to the experimental forests was the development of the natural area program. Since the Metolius Natural Area was formally established in June 1931, five additional ones had been established and six more were under consideration, which showed excellent progress in the 5-year period, considering the procedure required. Location of candidate areas was dependent

greatly upon cooperation and assistance of busy local forest officers. After location of areas, approval of forest supervisors was needed. Next, the area was examined by Station personnel, usually Isaac or Kolbe. Munger personally visited many of the areas proposed. With his background of 25 years, he was familiar with forest types throughout Region 6 National Forests. The area then had to be described in considerable detail and a proposal submitted to the Natural Area Regional In-Service Committee. After approval by this body, the proposal was subject to review and approval by the Regional Forester and, finally, was forwarded to the Washington Office for the Chief's formal approval which, although generally routine, was of necessity time consuming. The accomplishments in those 5 years were a tribute to Director Munger's dogged persistence and devotion to this little publicized program. Little use by scientists other than Station personnel had been made, partly the result of lack of publicity given the program. It was to be a number of years before ecology was to be a popular subject of study and added to the vocabulary of the reading public.

Briegleb returned to Portland after 3 months in the Washington Office early in the year having additional training in statistical methods and experimental design to assume Meyer's projects. The arrangement was to spend half of his time on the forest survey growth phase and related mensurational problems and the remainder on forest management projects. After McArdle left, Munger had added to the Director's duties personal supervision of forest management, including forest mensuration projects. Later in the year, Briegleb attended a 2-week course of lectures on statistical methods and experimental design given by Dr. R. A. Fisher of London, England, under the auspices of the School of Forestry, University of California at Berkeley.

In the fall of 1936, Lodewick attended the training seminar on statistical methods in the Washington Office conducted by Schumacher. The Products staff now consisted of Lodewick, Johnson, and Eric A. Anderson, who was appointed as a junior forester. Anderson filled the vacancy occurring when Rapraeger transferred to the Northern Rocky Mountain Station in August 1935.

Interest was commencing in the development of power-driven, portable chain saws for use in felling and bucking, and use of diesel-powered logging trucks, and Anderson was assigned to the job of collecting all available information on these subjects. The products division had long considered a survey of the use of dry kilns in artificial seasoning of lumber in the Douglas-fir region, but lacked the resources to conduct it. Through the use of ECW funds, Carl A. Kupfer, a dry kiln expert, was employed on a temporary basis to make the survey which was completed during the year. It confirmed a previous observation on the shift from natural draft to forced-air circulation dry kilns, and clearly demonstrated that the latter type gave more uniform drying, caused less degrade, was faster and obtained better drying through use of lower temperature, higher humidities, or both.

In October 1936, George M. Hunt of the Forest Products Laboratory visited the Station. During the course of his stay he, in company of Johnson and Anderson, called on the Western Pine Association laboratory[56] in Portland which had developed a new preservative, "permatol." He also visited the "Wolmanizing" wood preserving plant of the Crossett-Western Lumber Co. at Wauna, Oreg. The same group made a trip to Corvallis and looked over the Post Farm of the School of Forestry, a unique project established by T. J. Starker in 1927 to study natural durability of indigenous woods and test various preservatives for species for fence posts. This study now has over 50 years of measured experience.

Activities of the Division of Products continued to diversify, owing to pressures for answers to a wide range of problems arising from utilization of forest products. Port-Orford-cedar logs and "Jap squares" exports were a matter of concern to some people who believed that the limited supply of this species should be used for local manufacture and employment of labor. At that time, major domestic uses of Port-Orford-cedar were battery separators, venetian blind stock, small boat construction, and other specialty uses. These were labor intensive products compared with building and industrial construction lumber. The Japanese prized cedar for special building purposes and even in this early day were willing to pay premium prices. Other people were alarmed at

56 The Western Pine Association forest products laboratory was established in 1930 under the direction of Albert Herman.

the prospects of a scarcity of Douglas-fir peeler logs as annual production of plywood increased from 153 million square feet, 3/8-inch basis, in 1925 to 480 million square feet a decade later. If there was a scarcity, it was artificial, since there were large undeveloped areas of old-growth Douglas-fir in the region capable of yielding large quantities of peeler logs, even at the exacting size and quality grade specifications prevailing at that time. The problem was in the organization of the plywood industry which depended for its raw material on a logging industry geared to serve the sawmills. Within three decades some 8.5 billion square feet of Douglas-fir plywood was produced annually. These questions of timber supply scarcity were to appear from time to time with the same scenario but different casts and props.

During the 1930's, there was considerable interest in minor forest products generated in part at least by the depressed economy. The Station received inquiries from people probably seeking economic opportunities requiring little capital investment. The Division compiled annual price and other information on chemical products; cascara bark, cedar leaf oil, cedar wood oil, spruce leaf oil, Oregon fir balsam, and Canada balsam. Hardwood burls were also an item of study. Johnson handled most of this work, but the annual census of log, lumber, and shingle production and collection of price data of these products and stumpage continued to absorb a major part of his time.

A major undertaking of the products division in 1936 as well as other years was the program of mill-scale and grade-recovery studies in both the Douglas-fir and ponderosa pine regions. Usually all hands in the division worked on the fieldwork with help from National Forest Administration and the cooperating companies. The office compilation was the time-consuming part of the job; this could be done by permanent and temporary computers under Lodewick's supervision. In 1935, work was commenced on a series of mill-scale studies at sawmills cutting second-growth Douglas-fir. Fieldwork was completed in 1935 at two mills located at Molalla, Oreg., cutting logs from the Cascade Range slopes bordering the Willamette valley. In 1936, similar studies were made at three mills in the Sheridan-Willamina area cutting 70- and 80-year-old Douglas-fir from the Coast Ranges. Computation of the mass of data was underway in 1936.

The big effort, however, was in the ponderosa pine region of Oregon where mill-scale studies were made at sawmills of the Kinzua Pine Mills, Kinzua, and Ewauna Box Co. at Klamath Falls, Oreg. The mill-scale study at the Hines Lumber Co. plant near Burns was completed in the field in August 1935, and computation of the data was done in the spring of 1936. This provided millpond log values and lumber grade recoveries for the case study of the Burns Working Circle of the Malheur National Forest in southeastern Oregon which started in 1935. This is better known as the Hines study, which was the first major undertaking of Brandstrom and his section of logging economics in studying selective timber management in ponderosa pine. Other sections of the Station were working with Brandstrom and providing data on silvicultural stand structure, growth and mortality, slash disposal, and timber inventory. Integration of these data with logging cost and other economic data and their analytical interpretation was done by Brandstrom and staff and presented in his completed report. The focus of this project was an application by the Hines Lumber Co. for a change in cutting practice in their timber sale on the Malheur National Forest. Their sawmill was virtually dependent upon public timber for operation. The company had retained Donald Bruce[57] as a private consultant to make an analysis and report on National Forest cutting practices and on the timber supply situation as it related to their sawmill near Burns, Oreg.

Kolbe had developed considerable data on various alternative methods of cutting and their relation to tree classification systems from incremental measurements at 16-foot intervals on tree trunks during fieldwork on the pine growth and yield study, from periodic measurement of permanent and temporary sample plots, and observations on private cutting operations in the ponderosa pine region. The system of Dunning tree classes, which had been used extensively for a number of years in National Forest sales in the western pine region, was

57 At the time, 1935, that Bruce was retained by Hines, David Mason was manager of the Western Pine Association, have reassumed that position after leaving his NRA Lumber Code Authority position in the summer of 1935. Mason resigned his position at the Association January 1, 1936, and rejoined the consulting firm which became Mason, Stevens, and Bruce.

exposing inadequacies when subjected to economic valuation of its effects. This system was based solely upon silvicultural considerations in a traditional sense. It was an adaption of European forestry experience. At this time, Keen was introducing a new element, insect susceptibility, in classifying ponderosa pine trees and marking them for selective cutting. The Portland field office of the Bureau of Entomology had a series of 1/2-section, 320-acre, plots which had been measured for growth and mortality for a number of years. Keen used this data to evaluate trends in mortality loss. Using this information and supporting data available from other sources, Keen developed a tree risk classification based upon insect susceptibility, age, and vigor in terms of growth rate. This system, which included some silvicultural elements contributed by Kolbe, was used on the Hines sale area by Region 6. It had also been adopted by the Forest Service of the Bureau of Indian Affairs for use on sales of Indian Reservation pine timber in the West. Lee Muck and Ray Patrie, foresters for the Indian Service, had been following Keen's work closely and were pioneering its application on Indian timber sales. During this period, there was widespread interest in dendrochronology, historical analysis of annual tree rings, as indicators of climate and related natural phenomena. The western pines were favorite species for study owing to their sensitivity to climatic factors. Dr. A. E. Douglass[58] had aroused scientists to possibilities in this field of study by using tree ring counts and growth cycles to establish drought periods and relating these conditions to dating Pueblo Indian cultural fluctuations in the Southwest. Other institutions were interested in the subject as it permitted analysis of past, present, and prospective water resources for hydroelectric power, irrigation, and urban use in the Southwest. The Station was making a study of pine growth patterns using increment cores collected by the forest survey and silviculturists in eastern Oregon and eastern Washington for use in localizing growth predictions and other forest management projects.

A climax to the Hines study was a 3-day conference in the field to observe and discuss the application of principles developed by Brandstrom. Two sample areas, each 10 acres, were selected by the timber sale officer of the Malheur National Forest as demonstration areas. Timber on these plots was marked for selective cutting in accordance with the conclusions reached in his report. Bruce, in his report for the company, had arrived at essentially the same conclusions as Brandstrom. The major conclusion was the recommendation by Brandstrom and Bruce to make an initial cut of about 40 percent in place of the current practice of 80 to 85 percent on National Forest pine sales. Brandstrom and his assistants marked and numbered about 600 trees. Each tree was judged or measured and recorded for tree class, diameter and height, merchantable volume, log grades, net volume growth, marginal value on the stump, and response to release. Trees were marked for cutting by use of both the present system and the Brandstrom proposed system, which later was named the maturity selection system.

Attendance at the conference consisted of Assistant Chief Granger, E. E. Carter, and Kirkland from the Washington Office, Buck, Ericson,[59] and Ames from the Portland Regional Office, Supervisor Carl Ewing and C. W. Waterbury of the Malheur National Forest, and Munger, Brandstrom, Kolbe, and Meyer from the Station, representing the Forest Service; Keen from the Bureau of Entomology; and Donald Bruge, Charles Hines, president, and C. J. Pettibone, general manager, representing the company. The conferees spent a day in the field in the vicinity of Seneca and 2 days at John Day, where the supervisor's office was located, discussing results of the field examinations and considering proposals for modification. In brief, the marking resulted in taking trees valued at $2.50 per thousand board feet on the stump and higher. Some slight modifications were defined for silvicultural reasons after which Granger decided that the 40-percent cut would be tried until March 1, 1937, when the results would again be reviewed. The company was cutting about 100 million board feet at this time; accordingly, 4 or 5 months' operation should allow time for gathering additional information. In this interval, Brandstrom and Kolbe worked with the Regional Office to study light reserve stands on past cutting areas to determine mortality losses

58 Dr. Douglass was Research Associate in Climatology, Carnegie Institute of Washington, D.C.

59 At this time, Oliver F. Ericson was Assistant Regional Forester in charge of Timber Management and Ames was his assistant. Ames occupied this position or its equivalent from 1908 to 1934 when he was relieved of this position and replaced by F. H. Brundage. The latter held the position for about 1 year and then was made Associate Regional Forester.

and productivity and to gather log grade and stand structure data on timber removed and residual stand on the Hines area cut under the new system. This information was to be analyzed and presented before the 1937 meeting.

Two other case studies were commenced during the summer of 1936 by the section of logging economics at the Kinzua and Ewauna Box companies' operations. The studies complemented the Hines study, using the same general working plan with other sections of the Station cooperating. Variance in physical conditions and economic considerations of these studies provided information when added to the Hines data to make a comprehensive analysis of selective timber management in the ponderosa pine region. The Kinzua project was a cooperative study designed to determine if a sustained yield operation were feasible. This company was an owner of forest land and not totally dependent upon public timber. Cooperators on the study were the Station, Division of State and Private Forestry in the Regional Office, and the company represented by Bruce.

During the summer, Kirkland made another trip to Portland conferring with Munger and Brandstrom on followup studies of Douglas-fir selective timber management. The West Fork Logging Co. at Mineral, Wash., and the Grand Rapids Michigan Lumber Co. at Seaside, Oreg., were contemplating selective cutting operations on their timber-lands using Brandstrom's precepts.

Isaac added to his regular program a study of stand improvement possibilities in decadent old-growth Douglas-fir stands that were decreasing in net merchantable volume, a not uncommon occurrence in this region. One object of the study was to determine if such stands could be restored to a thrifty condition by girdling the decadent trees. This work was done on the Wind River Experimental Forest. Isaac continued his study of silvicultural effects of various kinds of partial cutting of Douglas-fir by running transects through such areas and recording data on wind-fall, release growth, decay, mortality, and stand damage. In addition, permanent sample plots were established on National Forest sales in advance of cutting where selective cutting of Douglas-fir was being tried experimentally.

Isaac and Meagher completed a study of natural regeneration on the Tillamook Burn, which developed silvicultural conditions governing restocking after crown fires covering large areas in the Douglas-fir region. On single bums, restocking was found to be proportional to the intensity of the fire; large areas subjected to a second burn were not restocking. The Tillamook Burn was doomed to have two more burns over much of its area during the coming years. Areas having occasional live trees surviving the bum, or fire-killed trees bearing cones that were not consumed by fire, proved to have adequate restocking. The report prepared by Isaac and Meagher as a mimeographed Station release received much public interest owing to the dramatic history of this fire. The report, which made the front pages of the Portland daily newspapers, pointed out the dangers of erosion on areas receiving second burns. Much of this area is in steep slopes and it receives unusually high precipitation. Annual rainfall of as much as 100 inches had been recorded at some stations. Under the public works program, two roads were constructed from Portland to the coast; one, the Wilson River road traversing the Tillamook Burn, and the other, the Wolf Creek road[60] crossing the Wolf Creek Burn, a smaller burn which occurred during the same time as the Tillamook fire and was situated immediately to the north of it. The Wolf Creek fire would have been a "headline" event in its own right if it had not been overshadowed by the Tillamook fire. These roads facilitated salvage of the fire-killed timber and aided fire protection of the areas. On the other hand, they increased the fire hazard in the areas by opening them to enlarged public entry, in hunting season, particularly, as the deer population increased.

An important activity of the fire research group at the Station was the development of a fire-danger rating board or meter which combined measurements of fire-danger factors such as fuel inflammability, humidity, wind, etc., taken at the fire-danger stations to show the class of day; four classes were used and shown in different colors on a board. These are now a familiar sight on forest highways. The bulk of the work on this study was done by a man assigned to the Station by the Regional Office to work under Matthews' supervision.

60 Later, the approximate location of the Sunset Highway.

The fire-weather equipment and Byram haze meters were now being used in many other forest regions of this country and two complete fire-danger stations and eight haze meters had been sent upon request to Tasmania.

Taxation of forest lands was still a live issue in the two States, and Munager, Wilson, and Kearns spent a great deal of time on various aspects of this problem, particularly as they related to the proliferating conferences and studies of land use planning and rural zoning by a number of agencies. In July a new study, National Forest contributions, was initiated here by R. C. Hall, acting director of the Forest Taxation Inquiry. This study, sometimes called contribution in lieu of taxes, estimated what tax returns to local government on National Forest lands would have been if the lands had been in private ownership. The study also evaluated benefits to local government from the allocation of a portion, 25 percent, of gross receipts from timber sales and other revenue-producing uses of the National Forests. Wade DeVries, a taxation economist, was detailed to the Station from the California Station to conduct the study.

With fieldwork on all phases of the forest survey completed during 1936, the staff could put in full time on report writing, map preparation, and answering the numerous inquiries for special information regarding the forest-land and timber resources. The success of the county report program for the Douglas-fir region prompted the writing of similar reports for forested counties of the pine region. Staff members in charge of the fieldwork for a county were also assigned the report writing job.

Supplies of the lithographed 1/4-inch-to-the-mile colored type maps were received for three of the quarter-State maps for Washington and two for Oregon. The remaining three quarter-State maps were still in process by the lithographer at year end. These maps were the first of the kind ever done on such a large scale in this country. Copies were distributed free of charge to cooperators, public and quasi-public agencies, and put on sale to others desiring copies. A nominal charge of $1 a copy was made to narrow the demand to legitimate requests. Funds received were returned to the Treasury as miscellaneous receipts.

Findings of the growth phase of the forest survey were analyzed and published June 1, 1936, in mimeographed form as Station Forest Research Notes No. 20, “Forest Growth in the Douglas-fir Region,” by W. H. Meyer, P. A. Briegleb, and the forest survey staff. Four kinds of growth calculation were made and presented in estimates of board-foot (Scribner) and cubic-foot volumes. These were (1) current annual growth; (2) realizable mean annual growth, an approximation of the growth that will actually occur in the future under forest practice prevailing in the past [61] (3) potential annual growth, the average annual growth that could be obtained on the whole of the region’s commercial forest land under intensive forest practice; and (4) periodic growth, the estimated growth in a 10-year period.

Throughout 1936, Andrews and Cowlin were giving major attention to writing the final forest survey report for the Douglas-fir region. Since this was the first regional report of its kind to be undertaken by the Forest Service, there were many questions of policy and procedure to be resolved. Earlier report on the extent and condition of the Nation’s forest resource by broad forest regions did not have the benefit of comprehensive and authoritative information and the burden it placed upon the analyst. Early in the year, drafts of several of the beginning chapters and a sample of the 11 regional unit reports which had been prepared by various members of the staff were sent to the Washington Office for preliminary review. It was the original intent to issue these unit reports in conjunction with the regional report as a publication of the Government Printing Office. It was decided that for the sake of brevity and speed in publication, the unit reports would be issued as Station mimeographs for local audiences. It was agreed that a greatly condensed statement be included in the final regional report, describing special features

61 Realizable growth was a new concept developed by Dr. W. H. Meyer. R. D. Garver, who replaced Granger as national head of the forest survey, and Dan S. A. Dana, on leave from the University of Michigan and currently a consultant to the Washington Office Division of Economics, visited the Station the fall of 1936 to review the forest survey reporting program and other activities. Garver questioned the realizable growth concept. Fortunately, Meyer was present to explain it in detail. Dana, a keen and perceptive scholar, grasped the concept at once and joined the survey staff in convincing Garver that it was a valid and useful growth calculation.

and conditions in six major districts of the region formed by combinations of the 11 units. It was also decided that the regional report itself should be made as brief as possible. A large part of Miss Jean Kerr's time was spent in editing forest survey reports. Other Station authors were also in line for her attentions. It was evident that professional editing was a full-time need at the Station, and Miss Kerr's detail to the Station was prolonged.

Several personnel changes of 1936 were noted earlier. In addition, Pratt, the last of three original timber experts to remain on the staff, transferred on July 1 to the Northern Rocky Mountain Station where the forest survey staff was being enlarged. As the nature of the forest survey program was changing with completion of the fieldwork, staff changes were appropriate.

At the meeting of the Forest Research Council held March 4, 1936, David T. Mason was elected chairman to succeed Aubrey R. Watzek. Some of the discussion centered around the urgency of obtaining congressional support for appropriations for the forest survey and other Station research needs. The forest survey had been singled out for reduction on the premise that emergency funds were available. The belief that the forest survey was a transient activity still flourished in some quarters. The Council firmly supported the value of the forest survey data and the necessity for keeping it current. At this meeting, the matter of use of forest survey data on private holdings by the Regional Office in studying cooperative sustained yield units was thoroughly aired. It was explained that the confidentiality of these data was respected and they would not be released without the written consent of the particular owner. Brundage further qualified their use by stating that only a lump-sum timber-volume figure for private ownership, without naming the owners, would be shown in public release. The matter of cooperative sustained yield management dated back to the Lumber Code days in 1934 and continued after NRA expiration. It was to continue to be a major interest of Chairman Mason until passage of the cooperative sustained yield act by Congress in 1944.

Mason again pointed to the need for study of range problems in the Douglas-fir region. At this time, the practice was developing of shipping bands of sheep from eastern Oregon and eastern Washington for winter grazing on the cutover lands of the Douglas-fir region.

A most important addition to the staff occurred on December 8, 1936, with the transfer of Gerald D. Pickford, forest ecologist from the Intermountain Forest Experiment Station to this Station. "Pick," as he was known familiarly, was placed in charge of the new Division of Range Research, made possible by the allotment of $11,850 to the Station for fiscal year 1937.

Addition of new programs of study and new funds and reduction in emergency funds necessitated many personnel changes in 1937. Elbert H. Reid, junior range examiner on the Snoqualmie National Forest, Region 6, transferred to the Station February 16, 1937, filling the range research staff. With no going programs[62] in this division, immediate attention was given to building a file and reference system. A major amount of time of the range research staff was given to the Western range survey, a cooperative project of Federal and State agencies involved in range management problems in the West. In preparation for this undertaking, Pickford spent a month in the Washington Office in February and March, assisting in revising range survey instructions with the purpose of standardizing survey methods in the Forest Service and, hopefully, with surveys made by other agencies. Participating in the Western range survey were the Forest Service, the Soil Conservation Service, the Farm Security Administration, and the Agriculture Adjustment Agency in the U.S. Department of Agriculture; the Division of Grazing and the Bureau of Indian Affairs in the U.S. Department of Interior; and in the Pacific Northwest, the Washington and Oregon Agricultural Experiment Stations. The Branch of Research acted as a coordinating agency nationally. Correlation and general supervision in Region 6 was assigned to the Pacific Northwest

62 With the exception of grazing use of Douglas-fir cutover lands underway since 1925. Results were summarized by Ingram in 1927 in an article published in the Journal of Agricultural Research. Later, the fieldwork was kept up to date by Isaac. This work was turned over to Pickford.

Forest Experiment Station. Fieldwork commenced in this region June 1, 1937. N. Talmage Nelson was employed to give the survey immediate supervision. He was a temporary employee of the Station at first, but later joined the Soil Conservation Service.

A flood control survey program was initiated at the Station with funds appropriated under the Flood Control Act of 1936. In administering the Department of Agriculture responsibilities under this act, the country was divided into a number of territories. In each of these, committees were organized to represent the varied interests of the Department. The committees' membership, usually three in number, was selected from pertinent agencies of the Department. Committee No. 22, composed of one representative each from the Bureau of Agricultural Economics, the Soil Conservation Service, and the Forest Service through the Pacific Northwest Forest Experiment Station, was assigned all of western Oregon, western Washington, and practically all of eastern Washington. Hearings were held at convenient locations throughout this territory for expression of public interest and opinion. The hearings were conducted jointly by representatives of the U.S. Corps of Engineers and the Department of Agriculture. During 1936, a total of 17 meetings was held by Committee No. 22. The initial meeting was held during January in Yakima, Wash., for the Yakima River Project, with Andrews representing the Station in place of Munger. A second was held in February at Salem to present a large downstream engineering works project on the Willamette River which the Army Engineers had been planning for some time. Public interest was keen, as flooding of this river and its tributaries was chronic. Some 450 attended this meeting, including the Governor. Colonel Robins presided during discussion of the engineering aspects and turned the meeting over to Director Munger for consideration of land use and management aspects of flood control.

Thereafter, Andrews represented the Station at nearly all of the meetings during 1937, and gave overall supervision to the flood control activities of the Station. Director Munger was on sick leave from April to September of 1937, and during his absence Andrews was designated as Acting Director in addition to his duties on flood control and the forest survey. Cowlin filled in for him in these capacities when needed. A flood control staff was being organized at the Station during the summer, and on September 1 Bolles was assigned from the forest survey to flood control for a 6-month period. On the same date, Dunford, who had been on the emergency financed rolls as a junior forester assigned to the Section of Silviculture, was given a regular junior forester appointment attached to flood control surveys.

Two meetings of Flood Control Committee No. 22 were held at the Station office during the summer. In preparation for these meetings, the drainage projects as specified by the Flood Control Act were shown on one large map of the region, and separate maps for each drainage district were prepared. Area figures were determined and other useful data assembled in folders for each drainage district. This work was done by the forest survey staff, using its maps and data as a starting point. At the first meeting held June 22, an outline for preliminary flood control reports was discussed, and allocation of responsibilities for each watershed was made to search of the three agencies. The Lewis River watershed in southwestern Washington was chosen for the first survey report. Procedures were agreed upon for division of labor and responsibility for each section of the report and interchange of preliminary drafts for review and coordination. Each member assembled factual material and made draft reports which were changed by mail. A second meeting was held on August 22, differences ironed out and revisions agreed upon, and assignments made for preparation of the final report. One day was spent in the field on the Lewis River watershed. Time and money did not permit any appreciable amount of fieldwork to develop new data. Reliance was placed on existing information.

Other additions were made to the regular staff during 1937. On January 16, Wade DeVries, senior forest economist, was transferred from the California Forest Experiment Station to make a study of certain aspects of the forest taxation problem in Oregon and Washington.

The Biological Survey assigned a forest biologist, A. W. Moore, to the Station for rodent control research and other wildlife problems of forest and range management.

Erna Jeppesen, Station librarian pro term, was given a permanent appointment as “under library assistant.” Her title belied her duties; she was the Station’s one and only librarian for that year and many more to come.

Losses of personnel were sustained, too, during this year. Paul D. Kemp, associate forester, was transferred to the forest survey project at the Northern Rocky Mountain Station on March 31. At this time, Region 1 and the Northern Rocky Mountain Forest Experiment Station had responsibility for Stevens, Pend Oreille, and Spokane Counties in extreme northeastern Washington. This condition necessitated close coordination of forest survey specifications and procedures between the two Stations in order to have uniform State statistical totals and type maps. Bradner and DeJamette of the Northern Rocky Mountain Station had made a number of trips to this region and knew Pacific Northwest Station procedures and personnel well.

During 1937, the final report of the forest survey for the Douglas-fir region was completed and sent to the Regional Office for review before forwarding to Washington for approval and publication. Editing was done in Portland by Jean Kerr.

Work commenced on keeping the survey current during the summer in Clatsop County, Oreg., and Grays Harbor County, Wash. The original survey of these two counties was done in 1931 and 1932. Heavy cutting had taken place in the comparatively short time that had elapsed, significantly altering the forest resource. The McSweeney-McNary Act as amended provided authority and funds for keeping the survey current. In the Pacific Northwest, the interval between periodic surveys could be varied to meet the situation in a particular county, a shorter period in counties where depletion was heavy and a longer period in counties where changes were not as severe. Work in Grays Harbor and Clatsop Counties furnished experience for perfecting survey techniques in both field and office work. Fieldwork in Grays Harbor was completed in December 1937 in spite of a record monthly rainfall of 26 inches.

County reports for each of the forested counties in the ponderosa pine region were completed and released in 1937. These reports gave the basic forest inventory data.

Briegleb was devoting a large part of his time in 1937 to completing the growth phase of the forest survey of the pine region in addition to many other current mensurational studies. Many complex computational problems appeared. Alinement charts for estimating in various pine types were constructed. In the fall, Briegleb spent several days in Missoula with the Northern Rocky Mountain staff discussing correlation of growth techniques between the two regions.

Early in 1937, Briegleb prepared growth estimates for a variety of hypothetical reserve stands on several proposed sustained yield units the Regional Office was studying in the pine region. One of these was called the Bend Sustained Yield Unit, which had many interesting features. The community of Bend, relatively new in central Oregon history, was dominated at that time by two large lumber operations whose establishment was chiefly responsible for the community’s growth and present economic support. These were the Brooks Scanlon Lumber Co. and the Shevlin-Hixon Lumber Co., both owning considerable acreage of timberland with the latter having the greater timber volume. Both operated large sawmills with box factory and planing mill adjuncts and had extensive railroad logging operations cutting their own timber and some National Forest, particularly on intermingled lands. In the spring of 1937, Brooks Scanlon made a comparatively simple test of the light maturity selection cutting principles developed by Brandstrom. Two representative sample plots typical of their timber holdings were selected; one, 40 acres, and the other, 80 acres. The timber was log graded and appraised by the Station’s Section of Logging Economics and marked for removing 50 percent of the total merchantable volume, consisting primarily of high-value overmature trees. Logs from this cut were sawn, graded, and tallied (volume), and results were recorded by the company. Next, the residual stand was logged and processed in a similar manner. With these data a comparative analysis was made of average logging and milling costs, lumber values, and net stumpage realization. To support this test, the Station’s Section of Forest Products conducted a detailed mill-scale and grade-recovery study at the Brooks Scanlon mill involving about 1,000 logs.

An objective of this study, sponsored by the Region 6 Division of State and Private Forestry, was to appraise the value of a cooperative sustained yield agreement between the Forest Service and the company, under which the company would practice the maturity selection system on their lands leaving a thrifty residual stand. The Forest Service would exchange stumpage from overmature stands on the Deschutes National Forest for the company lands bearing the residual stand. As a part of the Forest Service acquisition program described in the Copeland Report, exchange of National Forest stumpage for private logged-over lands was being used in the West as an effective method not requiring congressional authorization and appropriations. In some instances, counties were concerned at loss of tax-based property; however, the existing economic climate discouraged retention of private cutover forest land. This was not as true in the ponderosa pine region as in the Douglas-fir region, and tax delinquency and forest-land forfeiture was not an acute problem, but it was a factor for timber operators to consider during the current economic climate. Data from the Station's programs, principally the forest survey, forest products, selective timber management, and silviculture (methods of cutting in ponderosa pine and growth and yield studies), provided a wealth of data for analysis of prospective sustained yield management on private forest lands in this region, either through cooperative arrangements involving National Forest timber or through retention and progressive management of the private forest lands. In some cases, operating companies could augment their properties through acquisition of other private timberland or through purchase of stumpage from timber sales on Indian Reservations as well as on the National Forests.

Case studies in selective timber management in the pine region were reaching a climax this year, although work on the Ewauna Box and Kinzua studies was hampered by loss of temporary computing help through emergency financing reductions. The Hines case study had attracted great attention from foresters and lumbermen alike. At the request of the J. Neils Lumber Co. at Klickitat, Wash., a simple test of light maturity selection cutting was initiated on a 300-acre area of their property.

The first of the year, the logging economics staff analyzed the results of a log grade cruise made by Payne[63] of the 10,000-acre experimental cutting area on the Malheur National Forest which Hines Lumber Co. was logging under the test plan agreed upon the previous year. This cruise was made subsequent to the marking for the light selection cut. It confirmed the predicted values in Brandstrom's study analysis. For example, predicted volume removal was 40.8 percent and volume of timber marked was 39.7 percent; predicted average tree value was $4.97 and average value of trees marked was "on the nose." The average value of all trees 12 inches and larger in diameter on the area was predicted to be $1.95; the cruise showed it to be $2.04. The average value of a hypothetical cut of 85 percent, prevailing Forest Service standard marking practice, was $2.40 according to Payne's cruise compared with $2.65 predicted by Brandstrom's study.

The Hines operation was becoming a showplace as a result of the interest generated. In June, about 30 silviculturists from western Forest Service regions and experiment stations had a conference in this region and inspected and studied the maturity selection system as applied on the Hines sale area. Attending from the Pacific Northwest Station were Brandstrom, Kolbe, and Briegleb. G. A. Pearson from the Southwestern Forest Experiment Station also attended; prior to this time he visited the Cascade Head and Wind River Experimental Forests. Following the Hines conference, the traveling research silviculturists met at the Pringle Falls Experimental Forest. The group included Duncan Dunning and Austin Hasel of the California Forest Experiment Station; Kenneth Davis

63 Station monthly reports credit Philip L. Paine with this cruise. However, at that time Paine was in the District Office of Personnel Management and had no special experience in log grade cruising. On the other hand, Burnett H. Payne was on the supervisor's staff of the Deschutes National Forest at Bend and previously had worked on the Regional Office timber survey staff under Fred Matz. No other Paines or Paynes were employed in this region at that time.

of the Northern Rocky Mountain Station; Ewald Maki of the Intermountain Forest Experiment Station; R. F. Taylor of the Rocky Mountain Forest Experiment Station; G. A. Pearson of the Southwestern Forest Experiment Station;[64] Jay Price, Assistant Regional Forester of Region 5; Paul Keen of the Portland Forest Insect Office; and Brandstrom, Carlson, McKay, and Kolbe of the host Station. Director Kotok of the California Station was another critic of this study, labeling it "price tag forestry." At the outset, Brandstrom did not fully recognize silvicultural aspects. This was corrected after conferences with Kolbe and Munger, and the final report successfully survived its critics.

Earlier in the year, Kolbe and Brandstrom prepared plans and a sale report for cutting 520 acres of the Pringle Falls Experimental Forest on an experimental basis. The previous fall, 7,000 merchantable trees on the area had been tagged and numbered, and each tree was classified, log graded, and evaluated. The area was divided into seven permanent sample plots; trees on three plots were marked for silvical considerations, three strictly on the basis of financial selection, and one according to prevailing Forest Service practice. Marking was done in the spring of 1937 by Brandstrom, Kolbe, Carlson, and McKay, and the timber to be cut in the initial sale was advertised. Shevlin-Hixon Lumber Co. was awarded the sale and logging commenced in August. CCC enrollees marked tree numbers on the ends of each log for identification in a mill-scale study which was to follow after logging was completed.

Following the June Hines sale conference, Brandstrom made another trip in July with Earl Loveridge and Earl Pierce of the Washington Office, who were making a general integrating inspection of the Station and Region 6. Again, in August, he guided Pennsylvania's Governor Gifford Pinchot, Dean Henry Graves, and Herbert A. Smith of the Washington Office over the area. More travels were in store for Brandstrom as the gospel spread to the Southwest. He spent 3 weeks of the summer on detail to the Southwestern Forest Experiment Station to assist in starting a selective timber management study on the pine forests of the Coconino National Forest in Arizona. Like the Hines sale, this was to be a cooperative study with the Southwestern Station, Region 3, and the Southwestern lumber mills represented by Mason and Bruce participating. Brandstrom was to make the analysis and write the report for the Forest Service.

The year before, Brandstrom had performed in a somewhat similar capacity for the Southern Forest Experiment Station in New Orleans. He advised that Station on the conduct of study of the use of tractor logging on the operation of the Crossett Lumber Co. at Crossett, Ark., and outlined analytical procedures to be employed with the study data. In all, he spent a month on this trip.

In the Douglas-fir region, the prospects and problems for converting to selective timber management were not as clear cut (no pun intended) as in the pine region. Silvicultural and economic considerations were not as harmonious in the even-aged old-growth Douglas-fir as in the uneven-aged ponderosa pine forests. Tests of selective cutting were still going on both on private and public lands. The most intensive effort on private lands was that of the West Fork Logging Co. in western Washington. L. T. (Tom) Murray was thoroughly converted to the cause and had experimented with selective cutting in 1936.

The Station arranged a cooperative agreement with that company during the summer of 1937 to study and advise the application of Brandstrom's principles to their holdings near Mineral. A test area of 280 acres was set aside for an unusual logging experiment, involving individual tree selection on rough, steep ground and using heavy steam donkeys for high-lead yarding. The stand was predominantly Douglas-fir with mixtures of western redcedar, western hemlock, and white fir. The area was cruised and marked with only trees 40 inches and larger in diameter selected for cutting, except occasional salvage trees. An average of 44 percent of the total stand sawtimber

64 Pearson disagreed with Munger and others of the Station staff regarding the silvicultural values of the maturity selection system. Considerable correspondence and public statements between Munger and Pearson followed, explaining their differences. Later, Pearson damned the maturity selection system in the Pacific Northwest with faint praise in "Management of Ponderosa Pine in the Southwest," U.S.D.A. Monograph No. 6, by G. A. Pearson, 1950. Upon Pearson's death in 1949, his manuscript was incomplete. George Meagher, who worked with Pearson after transferring from this Station, completed it for publication in 1950.

volume was marked for removal. Part of this amount was in the shape of clearcut patches of heavily stocked stands with the result that volume scheduled for tree-selection removal was considerably less than 44 percent of the stand. The overall logging plan was to log the roughest ground in the winter with steam donkey and the best ground in dry seasons with tractors. The high-lead system was modified by hanging the high-lead block from a 75-foot spar tree instead of the customary 150 feet. This resulted in ground skidding except for a comparatively short distance around the spar tree. Care was to be exercised to minimize damage to the residual stand. In November, Munger arranged a “show-me” trip to this operation to review the experimental logging done this season. About 20 timber operators from the Puget Sound region, Munger and Brandstrom from the Station, and Hofmann and Lloyd Olson from the Regional Office attended. It developed that the company was able to use tractor logging on a larger part of the area than previously thought possible, and as a consequence enlarged the use of individual tree selection. Donkey logging was restricted to extremely rough steep ground and there some attempt was made at tree selection. Visitors were impressed with the potential of tractor logging. Forester observers noted that many details of selective logging from a forestry standpoint remained to be developed and tested. However, it was the consensus that this and similar other experimental work in the region forecast important changes in Douglas-fir management.

By this time, Brandstrom had lost all of his technical assistants for financial reasons, restricting progress on his studies, particularly on the analytical and report writing phase.

After reporting to the Station in January, DeVries informed himself on proposed tax legislation currently before the legislatures of the two States. He concluded that the Oregon bill was in agreement with the conclusions of the Forest Taxation Committee and in harmony with the Governor’s select committee on timber taxation. Munger, Wilson, and DeVries (when on detail the previous year) had provided that committee with technical information. Conversely, in its major features the Washington tax bill violated the taxation principles as stated by the Forest Taxation Inquiry in its publications. However, neither of these bills was reported out by the respective committees of the legislatures.

To commence his taxation program, DeVries developed plans for an intensive study of real property taxation in Skamania County, Wash. This county, bordering the Columbia River on the south, had special geographic features that created problems in county government and property taxation. The inhabitable portion of the county consisted of a narrow strip of mixed farm and forest land roughly 3 or 4 miles wide and 50 miles long from east to west. Dotted along the river were a few towns and rural communities. The hinterland was almost entirely forest land, much of it rough and mountainous. It was largely National Forest except for a block of intermingled Northern Pacific Railroad grant lands some 30 to 60 miles north of the Columbia River. These lands constituted nearly all of the timberland tax base and contributed nearly one-fourth of the property tax revenues of the county. One-half of the tax base of the inhabited portion of the county consisted of the railroad and public utilities connecting western and eastern Washington through the Columbia Gorge.

DeVries collected the 1936 assessed value of all parcels of land over 10 acres, plotted them on township maps, and made a forest- and rural-land ownership map. He found many opportunities for local government economies through school district reorganization. There were great variations between school districts in school buildings and facilities. A few districts, through gerrymandering, had captured remote bodies of tax-rich private forest land. DeVries advanced a plan of consolidating and reorganizing school districts to equalize their tax revenues and thus to eliminate some extravagances and upgrade educational facilities generally. A similar study was started in Pacific County, Wash., after completion of the Skamania County study. The land-ownership pattern in this county differed markedly from Skamania County.

At this time, the Forest Service in Regions 1 and 6 was in controversy with the Northern Pacific Railroad Co. over grant lands in Washington, Idaho, and Montana. The company alleged that they had not exercised all the land selection rights granted to them at the time the railroad was constructed and were claiming land now in National Forests. At the time of the original grant, much of this part of the country was unsurveyed, and even at this time

(1937) there were small mountainous areas lacking an official General Land Office survey. On the other hand, the Forest Service controverted these claims and asserted that the railroad had more land than due them. Also involved was consideration of land exchanges to block up holdings of both the railroad and the Forest Service. Regional Forester Buck requested DeVries' assistance on taxation aspects of this case. This involved conferences with Regions 1 and 6 personnel assigned to the case. DeVries estimated the capitalized future property taxes on the controverted lands. In making this study, DeVries found many vagaries in assessment practice and opportunities for improvement in taxing policies and practices of local government units. The Northern Pacific land case was to continue for a number of years and involve many Forest Service people in land examination, negotiations, and other related activities. It finally resulted in litigation in the Federal courts.

Activities in land use economics were becoming more varied and feverish. Planning boards and commissions were hard at work seeing solutions to the problems of private-land ownership exposed during the Depression. At the Federal level, the Resettlement Administration, working with the State Planning Board and Agricultural Experiment Station, was drafting rural zoning legislation. The Station cooperated in this project. Wilson was working closely with all these and similar groups in Washington, contributing information gained on the new public domain study of instability of forest-land ownership. Munger was a member of the Governor's Forest Tax Committee in Oregon. The long experience and knowledge Wilson had accumulated as a forester, banker, legislator, and his connection with the Clark Wilson Lumber Co. gave him a broad insight into fundamental land use problems in the Pacific Northwest. A major object in drafting legislation for consideration at the current session was to meet the requirements of the Fulmer Act.[65] Results of the new public domain study forcefully demonstrated that there were extensive areas of forest land in varying stages of passing from private ownership to public. Some counties delayed foreclosure of delinquent lands; others were considering turning tax-forfeited lands over to the State; and a few were considering retaining them for management. Others were thinking of holding the lands and returning them to private ownership when economic conditions improved. A number of counties had declared by word or inaction a moratorium on tax forfeitures of forest properties. Wilson made an intensive study of the situation in three Puget Sound counties. He concluded that moratoria did not appear to arrest the course of land abandonment for unpaid taxes and, on the contrary, delayed termination of tax delinquency and placing such lands under management and in stable ownership. The State of Washington had acquired a significant acreage of abandoned lands from the counties in the past few years and was making progress in managing tax-foreclosed lands. This State had authority to insist that such lands be turned over to the State Forester for management with any revenues from the land returned to the county after costs of management were deducted.

The Farm Security Administration had been making a study of another aspect of the rural land use problem. The Resettlement Administration, which functioned under the aegis of the Farm Security Administration, had made generalized land classification studies of Curry County, Oreg., and Grays Harbor County, Wash. Such studies were made in other counties where land use problems were considered acute. Lack of proper techniques for separating lands on the basis of value for forest, grazing, agriculture, recreation, and wildlife resulted in imperfect and confusing results. The attitude of livestock interests in Curry and Coos Counties, particularly with respect to their disregard of forest fire protection considerations, aggravated the situation. Many people believed that large areas of Douglas-fir cutover land could be converted to permanent grazing land through reseeding to annual and perennial grasses. This involved burning—often repeated burning—to remove encroaching brush, hardwoods, and second-growth conifers. This practice was going on in many places, but particularly up and down the Oregon coast where climate was comparatively moderate and rainfall heavy. Since adequate basis of experience and research was lacking, land classification surveys had to be highly generalized and tentative. The Station maintained that lands in doubt should remain unclassified until sound principles and criteria could be developed.

65 The Fulmer Act of August 27, 1935, was enacted by Congress to "provide for cooperation with the States in development of adequate systems of State-owned and State-managed forests."

Pressures were created by continued migration of people from the “Dust Bowl” to the Pacific Northwest. These people were largely from farms and rural communities and were seeking cheap land and jobs. Although this movement of people did not have the magnitude nor publicity that occurred in California, as popularized by John Steinbeck in “Grapes of Wrath,” it did have serious implications here. The land resources division of the Pacific Northwest Regional Planning Commission, of which Wilson was chairman, was working with other agencies to find answers to this problem. Many of these Dust Bowl migrants were settling on “cheap” lands that were marginal for farming under normal standards of living. On the other hand, the Resettlement Administration was purchasing marginal lands suitable for forest use but not for economic agriculture so that the owners could be resettled on suitable farmlands. Reclamation projects provided some of these opportunities. Some of the lands acquired by the Resettlement Administration were turned over to the Forest Service for administration as National Forests. This was a common occurrence on the Siuslaw National Forest which stretches up and down the Oregon coast mountains. The Cascade Head Experimental Forest was the beneficiary of several small parcels of private land acquired this way.

The Division of Forest Products, in addition to its mill-scale study program, had to field many requests for information on forest products utilization in connection with the multifold planning activities, reports, and conferences. A new project was commenced on telephone poles treated with arsenic paste as a wood preservative. This was to involve repeated examination along a series of telephone line installations.

Arthur Koehler of the Forest Products Laboratory was at the Station 2 days, correlating Station and Madison Laboratory work with Lodewick. Koehler gained world publicity by his identification of the wood in the ladder Bruno Hauptman employed in kidnapping the Lindberg baby. Tracing the wood led to Hauptman’s apprehension. Koehler and Lodewick visited the Western Pine Association laboratory in Portland, conferring with its staff who were engaged in studies of wood properties and seasoning methods.

Among other visitors at the Station during the summer of 1937 were Associate Chief Forester Clapp and C. L. Foresling who was recently appointed Assistant Chief in Charge of Research. That position had been filled by R. E. Marsh as Acting Assistant Chief from 1935 when Clapp was appointed Associate Chief. Prior to his promotion, Forsling was Director of the Appalachian Forest Experiment Station in Asheville, N.C.

The heavy emphasis on economic-related research and activities was a product of the times. The economy was beginning to respond to the wide array of governmental recovery efforts. Research programs in silviculture, phenology, genetics, and forest protection, i.e., fire, insects, and disease, were generally of long-term nature. Work was somewhat hampered by reduction of personnel resulting from loss of funds and diversion of the regular staff, but the continuing programs were moving forward and periodic remeasurements were kept on schedule.

During the year, 10 junior foresters, under appointment but paid from emergency funds, were lost to the Station. These men were all well qualified to remain in research and during their comparatively short tenure at the Station of several years’ duration, contributed much to the success of the projects employing their services. These were William H. Beeman, Roy C. Carlson, Stanton B. Hayward, David H. Judkins, Marion N. Nance, Walter E. Pelto, Boyd L. Rasmussen, Clarence W. Richen, Charles H. Williston, and Harry M. Wolfe. Seven were transferred to the regular rolls of Region 6 of the Forest Service. Three, Pelto, Williston, and Richen,[66] by choice took other positions in forest education or private forestry.

Important activities of the fire studies group were development of a fuel type mapping program and a fire replanning project for the Regional Office of Fire Control. Four junior foresters were detailed from the Region to the Station to work on these projects under Matthews and Morris’ direction. Matthews was also drawing together all material on Douglas-fir slash disposal in preparation for writing a report on this subject for publication. Morris spent several months in Washington on the training session on statistical methods and experimental design.

66 Richen, currently vice president, Crown Zellerbach Co., has had a distinguished career in private forestry association activities and as a member of Federal Forest Research Advisory Councils.

H. B. Shepard, who had returned to the Northeast Forest Experiment Station after completion of his forest insurance studies on the Pacific Coast, was at the Station for 2 months in the summer of 1937. His report was published in February of that year as U.S.D.A. Technical Bulletin No. 551, "Forest Fire Insuance in the Pacific Coast States." The report concluded that forest fire insurance in the Pacific Nortwest was "a feasible and profitable undertaking where proper precautions are observed." In the report's "Conclusions and Recommendations," a variable schedule of normal loss expectation and average premium rates was recommended. For the entire Pacific Coast, the normal loss expectation was 0.082 percent annually, and the annual average premium rate was 0.450 percent. For the Douglas-fir region, the values were 0.047 and 0.500 percent, respectively; for the pine region of Oregon and Washington, the values were 0.119 and 0.400 percent, respectively. The apparently high ratio of premium to loss in the Douglas-fir region was accounted for by the fact that conflagration hazard was not included in the loss expectation figures. While in the region, Shepard consulted with the Regional Office, State agencies, timber industry, insurance companies, and forest protective associations to determine their attitude if an offering of insurance could be made.

Passage by Congress of the O&C Sustained Yield Act in August of 1937 stimulated action on all fronts for establishing sustained yield management of private forest lands in cooperation with Federal forest lands. Prior to this time, the O&C revested lands were not under this type of management. The following year, David T. Mason, who was currently chairman of the Station's Advisory Committee, was appointed chairman of the Advisory Committee of the newly created Oregon and California Revested Lands Administration by the Secretary of Interior, Harold L. Ickes. Earlier in the year, Chief Forester Silcox, appearing before a House subcommittee on appropriations, made a forceful and provocative statement regarding the economic plight of forest-dependent communities, arousing interest in cooperative action of timber industries and public agencies to secure community stability and industrial prosperity.

In October of 1937, President Roosevelt made a trip around the Olympic Peninsula, arranged by Secretary Ickes who was promoting creation of an Olympic National Park which would include not only the Mount Olympus Primitive Area but also a considerable part of the Olympic National Forest. He was accompanied by a squad of Forest Service and National Park officers who acted as chauffeurs and guides. The atmosphere was a bit tense and Regional Forester Buck, who was not noted for tact or adroitness, was riding in the car with the President and made some unfortunate and undiplomatic remarks which had later repercussions.

The Station's financial situation worsened in 1938 as emergency funds were sharply curtailed and, accordingly, regular personnel had to spread their time and attention over a number of study projects which had been inaugurated during more affluent years.

On July 1, National Director Robert Fechner of the Civilian Conservation Corps decreed that no more CCC funds could be allotted for research use. However, on the experimental forests, CCC enrollees could be used for stand improvement measures, construction, and hazard reduction, since this work was conducted on National Forest lands, provided there were CCC camps within suitable travel distance.

In addition, the Station was allotted a monthly quota of 55 men (roughly 660 man-months) for the calendar year from the emergency relief appropriation. With the exception of 78 man-months applied to the Portland office, these men were manual laborers used at the Cascade Head and Blue Mountain Experimental Forests. Since job opportunities in the private sector of the economy had improved, the ERA work force reservoir contained the less skilled and less willing workers. Moreover, these men had to be rounded up from small communities near the experimental forests. Travel time and absenteeism (particularly on Mondays) reduced the work output and increased the burden on regular personnel supervising the projects.

Other more significant historical events occurred in 1938, unrelated to the financial problems. Director Munger returned to the office in September of the previous year from sick leave on a part-time basis, lengthening his schedule as his health improved. Andrews continued to serve as Acting Director, relieving the Director of

practically all administrative functions. Munger devoted his time to preparation of technical reports, attendance at selected meetings and conferences, and supervision of the work of the Section of Silvics. This situation moved into 1938, with Munger increasing attention to silvicultural studies, including slash disposal in the Douglas-fir region. For example, Christmas tree cutting in the Douglas-fir region was causing concern to foresters, as much of it was indiscriminate and harmful to future forest crops. Regulatory laws were under consideration in both States. Munger took a direct interest in this situation and spent some time in the field with Isaac investigating field conditions and problems. He also spent more time at the experimental forests reviewing study projects and status of construction of roads and physical improvements. Munger had retained a direct interest in silvical studies undertaken by Isaac and Kolbe from the time they commenced their forest research careers under his immediate direction and tutelage. The studies these two men were making were, as a rule, either ones commenced by Munger or conceived and prompted by him. In some cases, he participated with them in report preparation and authorship. During this period, Munger was actively concerning himself more intensely in the silvicultural aspects of selective timber management in the fir and pine regions, particularly the former.

In April, Munger and Matthews were completing preparation of the manuscript of their report on slash disposal after clearcutting in the Douglas-fir region, which was slated for publication as a departmental bulletin.

Loss of CCC research funds forced the transfer of Meagher to a vacancy at the Southwestern Forest Experiment Station. Before leaving, he and Isaac completed a progress report on natural reproduction on the Tillamook Burn 4 years after the fire, published as a Station mimeograph January 1938. He and Isaac also brought up to date the records of all the studies he had been engaged upon the previous 2 years, including the thinning of decadent old-growth Douglas-fir stands.

This left Isaac short-handed on Douglas-fir silviculture studies during the first half of the year. Kolbe was in a somewhat similar situation in the pine region.

Isaac's "Factors Affecting Establishment of Douglas-Fir Seedlings" was published as U.S.D.A. Circular 486 in 1938.

Relieving the personnel situation, the Regional Office assigned six CCC technical employees to the Station to give technical direction to projects connected with the CCC work program. These men were Douglas C. Welch and Theodore Kachin, junior foresters assigned to thinning studies; Loyd Bransford, in charge of Wind River Experimental Forest, and Donald F. McKay, assistant to technician, in charge of Pringle Falls Experimental Forest; and John Stevenson and Charles Harold, assigned to the fire control replanning project. The Regional Office paid the salaries and expenses of these men.

In May 1938, Thornton T. Munger was awarded the honorary degree of Doctor of Science by Oregon State College at its commencement ceremonies in recognition of his outstanding and long-time contributions to the progress of forestry in the Pacific Northwest.

By this time, Munger had decided to relinquish his administrative duties in favor of returning full time to technical research. Accordingly, he requested the Chief Forester to relieve him of the directorship and transfer him to the position of Chief of the Division of Forest Management Research at the Portland Station. This position had been officially vacant since Dr. McArdle resigned. Agreeing to this request, the Washington Office announced on May 25 that Munger was leaving the directorship effective July 1 and that this vacancy would be filled on that date by the transfer to it of Director Stephen N. Wyckoff of the Northern Rocky Mountain Station, Missoula, Mont. Wyckoff, a plant pathologist graduate of the University of California at Berkeley, had been in charge of the Spokane, Wash., blister rust control office of the Bureau of Plant Industry until 1936. At that time, he transferred to the Forest Service as Director of the Northern Rocky Mountain Station, succeeding Lyle F. Watts.

Andrews spent the month of May in the Washington Office, ostensibly to discuss final review of the forest survey Douglas-fir regional report and other Station matters. There is no doubt his career prospects in Forest Research and elsewhere in the Forest Service was a subject of discussion. Many at the Station and elsewhere in the Pacific

Northwest assumed that he would succeed Munger, since he had handled a difficult situation as Acting Director for a year or more very well and had previously demonstrated his capabilities as a forest research administrator and scholar as regional head of the forest survey and participant in related land economic studies and programs. “Hoss” Andrews was direct and candid with his associates in the Forest Service and the forest industries. He believed in getting at the heart of a problem and had no time for technical verbiage. He was not hesitant to state his position with equivocation, and if he disagreed with a Forest Service policy or decision in which he was involved or had knowledge, he would speak out spelling out his reasons. It may be that these characteristics obscured his abilities to analyze a forest problem and to seek all the pertinent facts before reaching a conclusion. There were reports that Andrews was being considered for the position of Associate Regional Forester in an eastern forest region since he had extensive previous experience with the State of Michigan and other Middle Western States.[67]

In August, soon after Wyckoff reported to his new position, Andrews resigned to accept appointment as Professor of Wild-Land Utilization, a Pack Foundation Research Professorship, at the University of Michigan. He also spent several months in the summer of 1939 as a consultant to the National Resources Commission in a land use study of the Northern Lake States. This episode had a happy ending, however, for the Forest Service, as Andrews returned to the Pacific Northwest as Assistant Regional Forester in charge of State and Private Forestry in Region 6, almost exactly a year later. Four years later, he became Regional Forester, succeeding Lyle F. Watts who became Chief Forester in 1943.

In many respects, this change of commands marked the passing of an era in the history of Forest Service research in the Pacific Northwest. Prior to 1924, research was organized as a rule on the basis of individual projects conducted by silviculturists or other biologists or by engineers doing forest products work. These men worked with considerable latitude and freedom from close direct supervision and gave almost exclusive attention to work on their projects. When the Experiment Stations were established in the early 1920’s, the skeleton of an organized research system was created. The first directors were selected largely on their proven ability as research project scientists, and with small research staffs the administrative burden was comparatively light, leaving time and opportunities for personal research. As funds increased and the scope of the study program widened and personnel increased in number, the situation changed. By the mid-1930’s, administrative duties were occupying nearly all of the directors’ time. Meetings, conferences, seminars, and a steady stream of professional visitors from abroad and this country seeking information on research methods and findings, usually people of a professional stature that demanded a director’s personal attention, preempted a considerable amount of time. The Washington Office of the Forest Service was starting to exercise stricter controls and making field inspections of study program conduct. More of the directors’ time had to be given to public relations activities and personal contacts to gain legislative support for the Stations’ work. At least, that appeared to be the situation here when Munger, who found this type of responsibility burdensome and in some cases downright unpleasant, decided to return to a position where he could be more intimately connected with the actual research work.

When Andrews left, Robert W. Cowlin was placed in his position as Chief of the Division of Forest Survey. The last of the 1/4-inch quarter-State colored lithographed type maps, that of northeastern Washington, was completed and the supply received for public distribution. This quarter-State had been held up to include type mapping of the three Washington counties that were part of the Northern Rocky Mountain Station territory, and also because of a poor color run on the proof copies. The report writing phase for the pine region was well along. Forest inventory statistical reports were issued for each county. The final comprehensive report for the Douglas-fir region was received for revision after Washington Office review, corrections made, and the manuscript returned for publication by the Government Printing Office. Requests for special compilations and analyses of forest survey data had reached such proportions that one man was occupied nearly full time performing this service. Among the special

67 The writer has good reason to believe Andrews understood he was going to be offered a position in National Forest Administration involving a grade promotion upon his return from Washington. However, no positive offer was made during the summer of 1938.

jobs, there were two in 1938 that were highly important. One was a special compilation of timber inventory, depletion, and growth statistical data for use in the Northern Pacific Railroad Co. controverted lands case. Owing to its Servicewide importance, this work took precedence over all other activities of the survey for 2 months. The other was preparation of forest-land and timber statistics covering the Pacific Northwest for inclusion in a national report to a joint congressional committee created by Senate Concurrent Resolution, adopted June 13, 1938, to study the forest situation in the United States. Although this study was not of the dimensions of the Copeland Report, it did present authoritative statistics on the forest resource, making use of forest survey data which were now available for the most important timber-producing region in the country.

The Western range survey project, which was occupying the immediate attention of the newly formed range research staff, was completed in this region, and the report and maps were prepared and forwarded to Washington. This was a nonrecurring project. This project and the development of more accurate methods of measuring forage utilization and forage production took all the time of the staff for the previous year and a half. Now, attention could be given to specific problems of range improvement that would have immediate application to National Forest range management. It was decided that for the time being, studies would be directed to the problem of improving forage conditions on mountain meadows within cattle ranges and still get full use of the forage on neighboring timbered rangeland.

Moore, of the Biological Survey, now affiliated with the Station, was filling a gap in regeneration studies. He initiated cooperative studies in tree seed consumption by small rodents and destruction of conifer seedlings by mountain beaver on the Cascade Head Experimental Forest. The most troublesome of the seed-eating rodents was the white-footed mouse *(Peromyscus).* Population studies of this pest were started since it was believed to be subject to population explosions. This phenomenon led to dubbing it the “promiscuous peromyscus.”

The large increase at the older experimental forests of projects and study installations requiring annual or periodic remeasurement required the attention of a resident forester yearlong, or at least all but the most severe winter months. In addition, the increase in buildings and physical service facilities resulting from the large construction programs of the prior few years caused a heavy schedule of maintenance jobs.

Isaac prepared a 20-year progress report on the restocking rate of a Douglas-fir clearcut area in the Wind River valley. He found conclusive evidence that reproduction came from wind-disseminated seed, not seed stored in the duff, in contradiction to J. V. Hofmann’s thesis.

The expansion of selective cutting systems of management in various forms in both the Douglas-fir and ponderosa pine regions on National Forest and on private lands was demanding more of Brandstrom’s time in giving technical advice on financial aspects and on show-me trips of various personages representing a variety of interests. Silvicultural aspects of “selective logging” received extra attention from Munger and Isaac in the fir region and Kolbe in the pine region. Over 40,000 acres had been cut over on the Silvies Working Circle (previously called the Burns Working Circle) of the Malheur National Forest since light selective cutting commenced in 1938. In the summer of 1938, Kolbe and assistants established a number of 1/2-acre permanent sample plots throughout the cutover area to follow the effects of this treatment upon growth and survival of the residual stand. With some established prior to cutting, such plots now numbered 400. In addition, 50 miles of strips were run for mortality determination. Kolbe also was called upon by the Regional Office to make a critical review of a sustained yield case study of a sustained yield cooperative study in central Oregon made by the Division of State and Private Forestry.

Regional Forester Buck was convinced that selective timber management in Douglas-fir should be adopted on National Forests of the region. He concluded that a large-scale demonstration of the principles and application of this method on National Forest timber sales should be made. The Mount Baker National Forest was selected as the general area to set up a model. A conference of National Forest administrative personnel and the Station,

represented by Munger and Brandstrom, was convened in April at the Verlot Ranger Station to decide upon policies and program of managing the Monte Cristo Ranger District of the Mount Baker National Forest as the model forest.

These areas had a high percentage of western hemlock, which had little market value at this time, in the fir stands, placing some constraints on this “experiment” as a model. In fact, many of the research and administrative staff of the Forest Service in this region were skeptical of this project’s success.

The Station also had initiated some small-scale tests of selective cutting on the Port-Orford-Cedar Experimental Forest in 1935 with the objective of determining a method of cutting that would increase the harvest volume of the valuable Port-Orford-cedar in preference to Douglas-fir and white fir. Reexamination that year indicated that as size of openings increased, white fir and Douglas-fir would overcome the Port-Orford-cedar regeneration. In places where there was advanced cedar reproduction at time of cutting and smaller open areas, the percentage of cedar increased.

During the summer, Munger and Isaac devoted considerable time to silvicultural aspects of selective cutting (also called partial cutting) in the Douglas-fir type. They visited a number of areas on both private and National Forest land where this type of cutting had been done and made close examinations of conditions on sample plots that had been established in advance of cutting.

The selective cutting operation of the West Fork Logging Co. at Mineral continued to draw attention and visitors, not only professional foresters and timbermen but also public personages. One group during the summer consisted of Secretary of the Interior Harold Ickes, John Boettiger, editor of the Seattle Post Intelligencer (better known as the son-in-law of President Franklin D. Roosevelt), a covey of western congressmen and senators, Chief Forester Silcox, and Assistant Chief Tinker. All were apparently impressed by this operation, although the silvicultural effects were yet to be determined.

At this time, Secretary Ickes was waging a vigorous and open attempt to add the Forest Service to the Department of Interior. Perhaps by coincidence, Secretary of Agriculture Henry A. Wallace, a more pacific person than his fellow cabinet officer, visited this region the previous year and viewed selective cutting in the pine type on the Malheur National Forest in company with Associate Chief Clapp. Gifford Pinchot and Henry Graves, as noted earlier, were also here in 1937 and also viewed the pine selective cutting studies. They were openly opposing the Ickes move to capture the Forest Service or dismember it and were organizing a public move to fight it. Sentiment within the top, middle, and lower echelons in the Service was to remain in status quo.

The products division had a full program of mill-scale studies and were spending considerable time on repricing early studies in the pine region using current timber product prices. The mill studies made at Flagstaff were completely analyzed and a report prepared providing Brandstrom with the material needed to complete his financial management study of the Rick Top Unit in the Coconino National Forest in Arizona for Region 3 of the Forest Service.

Fire control planning and fire-danger rating continued to be a major activity of the fire protection group. In cooperation with the Forest Products Laboratory, tests were made of the practicability of using chemicals in forest fire suppression. A fuel type map was made of a partial-cut area of 220 acres of the West Fork Logging Co. property, raising questions about relative fire hazards on such areas compared with virgin timber or clearcut areas. One of the moot questions was the credit which should be accorded tractor roads in rating resistance to control.

Briegleb gave considerable attention to mensurational problems in estimating growth and yield in ponderosa pine forests. He did additional work on preparation of supplemental site and stand structure corrections for Meyer’s “Growth in Selectively Cut Ponderosa Pine Forests of the Pacific Northwest,” U.S.D.A. Technical Bulletin 407. He discussed plans for revising and reprinting this bulletin with Dr. Walter H. Meyer between terms at the University of Washington.

The concept that a large proportion of tax-forfeited cutover lands in the Douglas-fir region could be converted to grazing land through seeding and establishing a sod cover continued to spread among county officials in Oregon and was extending into Washington. The motivation seemed to be realization of early public revenues. There was still a lack of physical, biotic, and economic criteria to reach sound conclusions, but the movement spread regardless. Wilson devoted much time and effort to working with Bureau of Agricultural Economics representatives in revising rural zoning measures for introduction at coming legislative sessions. Earlier in the year, he reviewed management plans for 80,000 acres of tax-forfeited lands in Clatsop County with the county court. Judge Boyington (in other political government terms, chairman of county commissioners) was more advanced in seeking permanent solutions to this problem than most other county judges.

Wilson continued to work with regional planning councils and boards on many land use problems and with the Portland Chamber of Commerce which functioned on many matters as a State chamber. He collaborated with the Northwest Regional Planning Commission in preparing a report entitled "Recent Migration in the Pacific Northwest," which was issued as a mimeograph May 1938.

Taxation studies, including local government reorganization opportunities, were expanded by DeVries. In December, R. C. Hall again visited the Station to review this work. Collection and analysis of tax problems of forest lands was beginning to influence thinking and actions of local government officials and other interested agencies and people. The Washington State Tax Commission was sponsoring a deferred timber tax bill. DeVries reviewed this bill and conferred with the Commission. This bill met many of the recommendations of the Tax Inquiry. A bill was also ready for presentation at the Oregon State Legislature providing for State assessment of timber property, another step in the right direction.

Director Wyckoff, after getting acquainted with Station programs and personnel, gave considerable personal attention to land planning activities and agencies. He had worked closely with the Washington, Idaho, and Montana State Planning Boards when he was stationed in Missoula and Spokane.

In March 1938, the National Resources Committee[68] published a report entitled "Forest Resources of the Pacific Northwest," prepared by the Pacific Northwest Regional Planning Commission. The publication consisted of three parts:

1. Report of Pacific Northwest Regional Planning Commission, a covering statement which included a forest program.

2. Report of the Forest Advisory Committee of the Commission, chaired by D. T. Mason. Other members were Deans Winkenwerder, Jeffers, and Spaulding, representing Washington, Idaho, and Montana, respectively, and C. J. Buck, representing Oregon. The report included a problem statement and recommended program of action.

3. Staff Report, forest resource conditions and problems, prepared by Consultant Donald Bruce and Blair Stewart, economist and member of the faculty of Reed College, Portland, Oreg. R. W. Putnam of the Region 6 Forest Service staff was assigned to the study as a representative of the cooperating agency.

Forest Service Regions 1, 4, and 6 and the Branch of Research contributed much of the basic information for the report. Sinclair Wilson served as a consultant and ex officio member of the Forest Advisory Committee, and gave a great deal of time and effort to this undertaking.

During the course of the study and review of the preliminary conclusions, the Forest Service raised some points of disagreement. Generally, these were ironed out by discussion.

68 Chairman was Secretary of Interior Ickes. Other members were Secretaries Woodring, Wallace, Roper, and Frances Perkins of the Cabinet, WPA Administrator Harry Hopkins, and public members Frederick A. Delano, Charles E. Merriam, Henry S. Dennison, and Beardsley Ruml.

CHAPTER IV FEDERAL FOREST RESEARCH IN DYNAMIC SITUATIONS FROM POSTDEPRESSION TO POSTWAR-1939-50

During the first decade and a half of the Station's history, the major problems of forest management and protection in the Pacific Northwest had been identified and analyzed in terms of major fields of study under Director Munger's leadership. Prior to the founding of the Station in 1924, pioneer professional foresters, including Munger, had concluded that the critical problems in this area were to develop adequate methods of protection against fire, insects, and disease and to learn effective means for restocking the large acreage of deforested burns and the increasing area of cutover lands. Another problem demanding immediate attention was that of timber measurements. Accordingly, sample plots, both permanent and temporary, were established to study forest regeneration under varying conditions, growth and yield, methods of cutting, and slash disposal following timber harvesting. Much of this early work was done by forest assistants attached to the staffs of the National Forest supervisors and the Forest Service Regional Office (first called District Office) in Portland.

Formal establishment of the Station in 1924 centralized forest research activities under single direction, responsible to the Chief of the Forest Service in Washington, D.C. By reason of fiscal necessity, priority in project selection and initiation of study programs was accorded the two major forest types of the Station's area of responsibility, Douglas-fir and ponderosa pine. These two major forest types not only contained the two most important timber species but also occupied by far the large part of the region's commercial forest land.

Douglas-fir and ponderosa pine furnished nearly all the raw material for timber manufacture, which dominated the industrial economy of Oregon and Washington and which was the principal source of capital and income for the economic and social development and growth of this region.

Munger personally participated in the first study programs of the newly established Station. The staff was small, consisting of Isaac in Douglas-fir silviculture and Westveld in ponderosa pine silviculture and an newly appointed junior forester, R.E. McArdle. Within a few years' time, Meyer and Kolbe were added to the staff greatly strengthening it; the latter replaced Westveld who left the Station to commence a career in forest education.

This small group of men contributed a wealth of basic knowledge which provided forest resource managers the primary tools to initiate progressive contemporary forest practices in protecting and managing this region's major natural resource.

During this period, reliable information was accumulated on behavior of Douglas-fir in even-age stands, including life of seed in the soil mantle, distance of seed fight and other information on seed dispersal, rate of restocking on different sites and under varying conditions, effect of burning on soil and cover, causes of seedling loss, and planting and broadcast seeding techniques. Isaac was the principal contributor to this body of knowledge, which was made available in a number of printed releases, addresses, and vis-a-vis discussions with practicing foresters. A milestone in this process was the publication in 1938 of his "Factors Affecting Establishment of Douglas Fir Seedlings," U.S.D.A. Circular No. 486. His work greatly enlarged the scientific understanding of the silvical aspects of the coast form of Douglas-fir and associated species.

The development and publication of normal growth and yield tables for douglas-fir by McArdle, with refinements and additions on their application by Meyer, was the cornerstone for most of the subsequent studies in Douglas-fir management and the preparation of working plans for sustained yield operations. For example, such silvicultural and mensurational data were necessary for calculating allowable cut values used in timber management operations on the National Forest. Using data from forest management research and lumber grade recovery data gathered by Lodewick and his forest products research staff, Kirkland and Brandstrom made definitive studies of the financial aspects of harvesting old-growth forests of the Douglas-fir region. Growth and yield studies of spruce-hemlock stand made by Meyer extended the scope of their investigations. The advent of tractor logging

and motor truck transportation was a prime factor in leading Brandstrom and Kirkland to conclude that partial cutting promised immediate profits and was a superior method of cutting old-growth stand in the Douglas-fir region in most cases. Pointing to greater opportunities for flexible operations and increased financial returns, they advocated its widespread use in managing private and public forests.

Inadequate recognition of silvical requirements for regeneration and lack of prior knowledge of adverse effects upon the residual stand arising from tractor logging and partial cutting caused increasing concern by many Pacific Northwest foresters of the wisdom of this radical change in established practices. This attitude was compounded by the difficulty of abating the slash hazard on partially cut areas ant the fact that it spread the slash over a larger area. Munger and Isaac were foremost in the group critical of wholesale conversion to partial cutting in old-growth Douglas-fir forests, and friction developed between Director Munger and Regional Forester Buck on the issue. Buck was determined to convert cutting on National Forest timber sales to this practice despite some lack of agreement and support by members of his staff and field forest officers (Munger called it “muffled disapproval”).

As far as the ponderosa pine region was concerned, there was greater unity among Station researchers on the optimum method of managing the uneven-age forests. Pioneer studies by westveld and Munger, augmented and strengthened by Kolbe’s later work, provided a firm silvicultural base for development and application on a large-scale pilot basis of the maturity selection system of ponderosa pine management. This system resulted from the introduction by Brandstrom of financial considerations into the classification and marking for cutting of the various age and vigor components of the typical ponderosa pine stands of eastern Oregon and Washington. Another critical factor, susceptibility and loss probability from pine beetle attacks, was integrated into the system resulting from Keen’s studies and conclusions.

Mensurational studies by Meyer and Briegleb added substance to the broad base of knowledge needed to predict consequences of the recommended degree and nature of cutting. Studies of growth and yield in uneven- and even-age stands of ponderosa pine had been completed and published in bulletin form by Meyer. Briegleb added several articles to the store of information on application of Meyer’s data in actual practice, and his studies of growth prediction provided techniques for use in stands cut over under the maturity selection system.

Munger initiated genetic studies in the two major species early in the Station’s history, and by the end of this period two sets of plantations, one of fir and one of pine, had been under observation long enough to identify desirable seed sources for reforestation. However, Munger recognized this was only a bare beginning in this important field of study and advocated greater emphasis in study of regional strains and local variation in the two species.

Station forest fire studies, carried on by McArdle, Simson, Matthews, Morris, and helpers, were directed mainly to solution of pressing problems of immediate value to fire protection agencies and included fire-weather measurements and instrumentation, fire behavior, fire effects, fire control planning, and slash hazard abatement. The basic policy in program planning and study selection was to work closely with National Forest Administration and other public and private forest protection agencies. Under this policy, considerable cooperative assistance (chiefly from the Regional Office) was given the Station in manpower and funds to beef up the program. The vast amount of fuel created by prevailing cutting practices and the low degree of wood volume utilized, particularly in the Douglas-fir region, and the history of repeated catastrophic fires in the Pacific Northwest were determining factors in shaping the fire investigative program.

Forest insect and disease study programs are also aimed at urgent major problems that were causing severe losses of merchantable timber and costly control measures. Pine beetle and hemlock looper epidemics and invasion of five-needle pine stands by white pine blister rust were obvious examples of these problems. Heart rot in overmature Douglas-fir and rate of deterioration of logging slash and windthrown timber were other examples

of problems attacked by the undermanned staffs of entomologists and pathologists. Giving technical assistance to the agencies carrying on control programs absorbed much of their efforts, leaving insufficient time for enlarging the basic knowledge of the indigenous forest insects and pathogens.

Completion of the initial forest survey of the Douglas-fir and ponderosa pine regions made available reliable and detailed information on the forest inventory, rate of depletion by cutting and fire, and rate of growth by forest-land ownership class localized for areas as small as a county. Less was known concerning endemic losses of timber volume and growth potential from insects, disease, and windthrow. However, records of losses from epidemics and catastrophes, such as the Olympic blowdown, were reasonably reliable. Need for greater attention to these problems was recognized but would have to wait for increased funds for manpower and physical facilities.

With the forest survey information at hand, problems in forest management and protection, forest products utilization, and forest economics could be put in perspective and quantified. Completion of the forest fire insurance study by Shepard was a one-time thing which could be put on the reference shelf for other people and agencies to use when economic and political conditions were appropriate. The forest taxation studies by Wilson and DeVries, although of longer life and more pertinent than the insurance study, were soon to reach the stage where action agencies and legislatures should take over and free the forest economics research staff to tackle many other pressing problems.

Availability of the wealth of forest survey localized information on the forest resource was timely and indispensable for the various depression-born agencies active in land use planning at the county, State, and regional level. It was also essential to cost-benefit analyses in planning public works such as development of hydroelectric power-generating facilities, river and harbor improvements, flood control measures, and extension of overland and water transportation systems. Timber companies and supporting industries, including banks and investment companies, were other users and beneficiaries of these data in industrial planning.

The fact that the research effort of the Station had been directed almost entirely to the use of the forest resource for commodity production was not from lack of appreciation of other values and other problems. Munger was fully aware of this gap in the Station's program. A small beginning had been made in range management research and watershed management (through the flood control studies) and a small amount of attention had been given to wildlife management and forest recreation by the end of this period in the Station's history. However, public interest and legislative support for an adequate research program in nontimber uses of the forest resource would not develop until economic conditions definitely changed for the better and the political economy of the Pacific Northwest matured.

The style of Station administration changed under Director Wychoff's directorship, but the essence of the going programs continued much the same as before. Wyckoff was interested chiefly in broad concepts and not in technical aspects of the investigative program, content to leave the division chiefs great freedom in their day-by-day jobs, judging their performance by end results. He delegated much of the decision making and responsibility for completed jobs to staff members. He had a philosophical attitude toward many of the chores that troubled Director Munger and probably other research administrators of that day. He was intensely interested in the land use planning activities that were at a peak, or nearly so, during the end of the depression period. Wyckoff avoided confrontations on controversial issues, seeking a compromise settlement. After getting established in the Director's chair, he gave early attention to improving public relation activities of the Station and smoothing over in-Service rough spots that had developed in the past few years.

Wyckoff considered sustained yield forest management not only as the chief objective of forestry on private and public lands but also as an ideal or perfect model for social as well as economic ends. He saw the job of forest research to be the accumulation of knowledge to bring forest management practices closer to attainment of that ideal.

No new study programs were undertaken during 1939 and no major publications were completed or published. Because of restriction from a tighter fiscal situation and rising costs it was a time for settling down and getting into gear after the changes in command. With the economic recovery process underway after the 1938 recession,[1] emergency funds were being either phased out or reduced. Allotment of regular funds remained at about the same level as the previous year with two exceptions: funds for the forest survey were reduced about one-third and the money was diverted to other Stations where this work was being initiated or accelerated. This was anticipated as the reinventory work in this region was of lower priority. On the other hand, flood control funds were sharply increased over the amounts received previously. In view of this increase, Raymond H. Chapler was appointed as Senior Forester in Charge of Flood Control Surveys in the middle of the year. Chapler was secretary-manager of the Oregon Forest Fire Association for a number of years prior to joining the Station. However, he had been in National Forest Administration in earlier years. About the same time, Junior Forester Dunford transferred to the Rocky Mountain Forest Experiment Station where he started a career in watershed management research that was to bring him back to this Station years later.

Some projects at the Station continued to benefit from ERA money through WPA labor and "white collar" projects. Region 6 of the Forest Service also assisted forest management research programs by financing CCC junior foresters and assistant technicians as crew foremen in charge of CCC crews working on stand improvement projects and maintenance of physical improvements at the Pringle Falls, Wind River, Cascade Head, and Port-Orford-Cedar Experimental Forests with heavy emphasis on the first two named. The Blue Mountain Experimental Forest was "put on the shelf" until financial conditions improved. Actually, there was a serious question raised regarding the desirability of developing and maintaining this facility. Work on forest management projects in ponderosa pine was being limited to essential plot remeasurements and similar activities as funds and personnel were being diverted to the Douglas-fir region to strengthen work there where critical problems and issues concerning methods of cutting practices urgently needed resolution.

Kolbe was working with Brandstrom on large-scale experiments of installment cutting of old-growth Douglas-fir and western hemlock being carried on in cooperation with the Simpson Timber Co. in the South Puget Sound area. Five installment cuts were made successively during an operating season on a 160-acre tract to determine silvicultural, fire protection, and economic aspects of this method of cutting. After each cut of increasing intensity, slash hazard was rated, damage to residual trees through felling and yarding was measured, other silvicultural effects noted, and records taken of economic loss from breakage, log grade recovery, and comparative operating costs and returns.

In response to the Regional Forester's recent edict that selective cutting should be the policy on National Forest timber sales, many forms of that general cutting method were being practiced experimentally, including harvest cuts, improvement cuts, salvage operations, value selection cuts, and release cuts. Station personnel were able to establish permanent plots on many of these cutting areas in advance of logging to measure timber volume utilized and lost, lasting injury to the residual stand, percent of decay, change in species composition, and resulting fire hazard. Followup measurements of windfall, insect and disease losses, and growth of the remaining stand were planned.

As evidence accumulated on adverse silvicultural effects of the varieties of partial cutting being followed on private and public timberlands through observations and preliminary studies of the Station's forest management staff, Munger took a more positive position. He used several forums to express his criticism, ushering in the New Year

1 Under the aegis of Roosevelt's administration, deficit spending was used to solve the Depression's economic problems. In 1938, Roosevelt balanced the Federal budget and the economy faltered, and the term "recession" was added to the economist's vocabulary. In 1939, financing of recovery jobs was renewed, although the Station's research program was not noticeably benefited.

with a climactic address before the Puget Sound Section of the Society of American Foresters at Seattle on January 6, 1939. The subject of his address was “The Silviculture of Tree Selection Cutting in the Douglas-Fir Region.” Buck objected strenuously[2] and tried to block subsequent publication of the article by appealing to the Washington Office. His appeal was rejected and Munger’s article was published in the Forest Club Quarterly of the University of Washington, March 1939.

Rereading this article 35 years later, one would conclude that it was not hypercritical; neither did it reflect personality issues nor “point the finger,” to use common-day vernacular. It appears to be a calm and objective analysis of the situation presented in a scholarly manner. Munger opened his paper by observing that “silviculture is not an end in itself” and that “it is not good silviculture that is not economically most profitable.” He described some of the abuses of clearcutting as it had been practiced in the past; in particular, the “absolute clearcutting of large continuous areas,” which made fire protection difficult and natural regeneration of much of the area uncertain or hopeless. He pointed out that clearcutting was a sound and proven silvicultural system when properly practiced. Munger also clearly stated that in discussing the silviculture of selective logging, he was speaking chiefly from general observations rather than from scientifically designed and controlled experiments. This was in contrast to the large store of knowledge accumulated by the Station staff and other researchers on the silvical characteristics of Douglas-fir and western hemlock in even-age stands and their behavior following clearcutting.

Munger defined four classes of partial or selective cutting: (1) thinning, (2) installment cutting, (3) zero margin cutting, and (4) true tree selection cutting. He dismissed the first three classes as not relevant to the central question in the issue under review, which he defined as “are our tree species (Douglas-fir and western hemlock) suited to even-aged or uneven-aged forest management, recognizing that tree selection inevitably leads to uneven-aged stands and clearcutting produces even-aged stands?” Munger positively stated that all evidence showed that in this region Douglas-fir and western hemlock reached their optimum development in even-agedstands.[3]

Munger made a careful distinction between selective timber management and the “selection system” of silviculture or “selective logging” as currently named and practiced in the Douglas-fir region. He defined selective timber management as a policy of economic forest management that may employ any type of silviculture, inferring that in some cases tree selection might be appropriate.

He stated that thinning is beneficial practice in immature stands, particularly for second-growth Douglas-lfir, but it has nothing to do with the selection system of silviculture although often called selective cutting. About this time, a sale of piling had been made to be cut from second-growth Douglas-fir stands on the Wind River Experimental Forest, giving the Station opportunity to conduct studies in commercial thinnings. Increasing attention was being given to the problems of second-growth management of Douglas-fir and to the need for an expanded research program on this subject. Conclusion of the initial forest survey of the region and publication of the inventory growth and depletion data called attention to the diminishing supply of old-growth and the increasing importance of second-growth management of Douglas-fir and to the need for an expanded research program on this subject. Conclusion of the initial forest survey of the region and publication of the inventory growth and depletion data called attention to the diminishing supply of old-growth ant the increasing importance of second-growth in the regional timber supply situation.

2 The record does not show if Buck had the opportunity to review the text of Munger’s address prior to delivery, but this writer suspects not. Since Munger was asked by the chapter’s program committee to present this subject, Buck probably had wind of Munger’s intentions.

3 Continuing research and forest practice in the quarter century or more following this statement affirms his conclusion.

Munger dismissed “zero margin” cutting or logger’s selection (some called it high grading) as incompatible with “good silviculture.” He also observed that installment cutting or “stage cutting” is either zero margin cutting or clearcutting, since the cutting takes place in a short time span. He defined group selection, area selection, and strip cutting as a “form of clearcutting in miniature” and said it should have a large place in Douglas-fir silviculture.

Munger concluded that true tree selection cutting had both short-term and long-term economic advantages in certain cases. He compared the disadvantages and advantages for the following silvical aspects of “light tree selection” and clearcutting: (1) esthetics and water conservation, (2) seed supply, (3) even-aged versus uneven-aged stand structure, (4) volume production, (5) fire hazard, (6) windfall, (7) insect losses, (8) logging damage, and (9) preserving forest conditions.

Summarizing, Munger enumerated the silvicultural disadvantages of selective cutting but pointed to the advantage of better esthetic values, watershed protection, and seed supply compared with clearcutting. He warned against looking to selective cutting as a panacea for mistakes of past clearcutting.[4] Quoting the German forestry axiom, “Der plunterwald muss nicht ein plunderwald warden” (The selection forest must not become a plunder forest), he warned that “selection cutting can easily degenerate into high-grading.” He stated that clearcutting can be made much more effective and successful by limiting the size of cutting area and improving fire protection of cutover areas.

Munger concluded by warning against “blanket rules” and used another of his favorite quotes from Professor R. T. Fisher of Harvard that a true silviculturist avoids general rules but practices forestry “by the square rod.”

To understand the basis for the controversy between Munger and Buck, one would have to know the contrasting personalities of the two men and the probability of previous and long-standing differences of opinions as well as the scientific merits of this particular issue. Suffice it to say the two were not simpatico.

On the other hand, Brandstrom and Munger respected each other and remained friends regardless of differing opinions and attitudes regarding forest management policies and methods. In fact, the two were not far apart on the ultimate objective and system of managing old-growth Douglas-fir forests.

A few months after this episode, Regional Forester Buck was transferred to the Washington Office of the Forest Service. He was replaced as Regional Forester by Lyle F. Watts, then in charge of Region 9, the North Central Region, headquartered at Milwaukee, Wis. By the end of 1939, relations between the Station and the Regional Office were again on an even keel. Watts had a research background as well as experience in National Forest Administration and an appreciation of the importance and place of research in the Forest Service. He had qualities of leadership, objectivity, and statesmanship that led to improvement of relations of Region 6, not only with the Station but also with the forest industries and other public and private forestry-related agencies. In addition, Watts and Wyckoff had worked together very harmoniously in the Northern Rocky Mountain Region. Late in 1939, H. J. Andrews rejoined the Forest Service as Assistant Regional Forester in charge of the Region 6 office of State and Private Forestry. This provided another tie between the Station and the Region.

4 An observation some of the latter-day ecologists and conservation advocates of universal clearcutting might do well to consider carefully. Munger’s credentials as an ecologist and working conservationist are indisputable. Witness his recognition of esthetic values, his lifetime interest in natural areas, the Portland Forest Park, the Forestry Museum, the Audubon Society, the Oregon Roadside Council, the Oregon Museum of Science and Industry, the Save the Myrtles League, and many other similar activities.

While all this was going on, lower echelon research activities were working well in the field on the National Forests. For example, Station personnel developed tools and gave instruction in methods for precommercial thinning and pruning young-growth Douglas-fir and ponderosa pine to many CCC foremen and crew members.

Fire protection and control continued to be one of the most pressing problems demanding increasing attention. Publication of forest survey inventory data emphasized the magnitude of this problem, showing the large acreage of deforested burns and nonrestocking cutover lands, their location, and ownership class. The Station's study program had been largely directed to fire behavior and fire control. A movement was underway nationwide to develop a national fire-danger rating system, a field in which the Station had done pioneer work. Although results of the Station's fire studies to date had general application, many of the specifics were directed to the problems of the National Forests. The fire protection committee of the advisory council[5] called attention to the urgency of the problem of preventing and controlling of fires on logged-off lands, most of which were privately owned and under the protection of State or association fir protection agencies. Accordingly, the Station's program was reoriented to study how adequate fire protection could be given these lands. Snohomish County, Wash., was selected for a case study principally aimed at determining the cost of effective protection. A working plan was prepared and field information gathered on physical and economic factors. During the course of the study, there were frequent consultations and cooperation with State and Associations personnel and county officials. After the data were analyzed, conclusions were drawn and recommendations made for review by the council prior to release.

Countering the slowdown in forest management research in the ponderosa pine region was intensification of range management research in this area. Work prior to 1939 led to the conclusion that for some years to come, all available resources should be concentrated on cattle management studies on National Forest summer ranges. This decision called for the selection and establishment of a permanent work center for range research. The Starkey allotment on the Umatilla National Forest, which had been used in the range reconnaissance surveys, met all the specifications for such a facility admirably. Steps were taken to have the area officially designated as an experimental range in time to plan physical improvements and develop an experimental design for the study program during the winter. This would permit start of fieldwork early in the spring of 1940.

During 1939, the cooperative study of comparison of range surveys progressed. The study area (the Starkey area) was photographed from the air and a vegetative type map prepared. Fieldwork was completed by mid-September and compilation of results completed by the year end. Shortly after, Reid and M. Talmage Nelson of the Soil Conservation Service went to Washington, D.C., to analyze the data and prepare the completed report.

During 1937, an infestation of the Great Basin tent caterpillar *(Malacosoma fragilis)* defoliating large areas of bitterbrush *(Purshia tridentata),* an important forage plant, was detected on the Deschutes National Forest. It reached epidemic proportions in 1938 and repeated in 1939. During the summer of 1939, a cooperative study was commenced by the Bureau of Entomology and Plant Quarantine and the Station.

The flood control group completed preliminary flood control reports for the Nooksack River basin in western Washington, the Willamette in western Oregon, and the Tanana River in Alaska. Of particular note, however, was the making of a plan for a detailed flood control plan for the Walla Walla watershed in the pine region. This was the first such survey in the Pacific Northwest to be undertaken by the Department of Agriculture. The area includes both forest and range lands with a wide range of vegetative cover. Irrigation is an important agricultural use of the river waters and annual flood damage had been excessive.

5 The council had been organized several years before into subject matter subcommittees. Several of the original council members were still serving, including E.T. Allen, C.S. Chapman, D.T. Mason, and Deans Johnson, Peavy, and Winkenwerder. Colonel Greeley, who joined the council a few years after it formed, was also still a member. In addition to advising the Station on needed research, it also served as an informal forum for discussing more general forestry problems of mutual concern of the Forest Service, States, forest schools, and private forest-land owners and operators. Since the Regional Office of the Forest Service did not have an advisory group, this body served as a point of contact between the Regional Forester and these groups.

Late in 1939, Wyckoff, Lodewick, and Brandstrom attended an interregional conference at the California Station, convened to discuss current status of ponderosa pine log grade studies and, hopefully, to agree upon a set of integrated commercial and research log grades applicable over the entire range of ponderosa pine. Representatives of the five western Experiment Stations, western Regional Divisions of Timber Management, the Washington Office, the Madison Laboratory, and the Western Pine Association attended. After 3 days of discussion and field demonstrations at the Feather River Experimental Forest on the Plumas National Forest of Region 5, a committee of three was appointed to formulate the new set of standard log grades. The committee, consisting of E. F. Rapraeger, T. J. Orr,[6] and J. E. Lodewick, representing the Northern Rocky Mountain, California, and Pacific Northwest Forest Experiment Stations, respectively, met in Portland in mid-December. At this session, the new rules were developed, approved by the committee, and proposed for adoption as official by the Forest Service and the pine industry.

The forest survey staff completed a draft of a comprehensive report on the forest resources of the ponderosa pine region of Oregon and Washington in the fall of 1939 for review prior to publication. The corresponding report for the Douglas-fir region was moving slowly through the publication channels. Reinventory of the Douglas-fir region was moving ahead; one of the counties completed was Snohomish County, Wash. Availability of up-to-date information proved useful to the fire control case study of that county. Among a number of special studies completed by the forest survey staff during the year was supplying information to the Washington State Planning Council and the Regional Office for use in studies of a proposal for a Cascade Mountains National Park.[7] This proposal originated with the National Park Service and its more militant supporters. The North Cascades proposal was reported to be a part of a greater plan to establish a series of national parks surrounding each of the snow-capped peaks of the Cascade Range from the Canadian border to the California line; each of these parks was to be connected by a strip of park land along the crest of the Range. Some of the more ambitious of the proposal's advocates suggested it might be extended along the Sierra Nevada in California. The Washington State Planning Council staff considered this proposal and requested the forest resource analysis by the Station. The Council recommended against the park proposal, urging that the land remain in National Forest.[8]

With the completion of reports on the series of grade recovery studies in the pine region, attention of the Station's products staff could be given to similar studies of Douglas-fir and associated species. This division was reduced in strength by the resignation of Eric Anderson in November 1939 to engage in a 2-year doctorate graduate study program at New York State College of Forestry.

Tax delinquency and foreclosures continued to increase, particularly in western Oregon and Washington. Wilson and DeVries continued to give information and advice to public and private agencies on the nature and extent of forest-land taxation and related problems.

Progress was being made in some remedial measures, particularly in getting these lands into stable ownership by organizing State forests or setting up disposal or progressive management policies at the county level.

6 T. J. (Tom) Orr later became chief forester for Weyerhaeuser Timber Co. operations in the Klamath Falls area of Oregon and active in forestry matters in eastern Oregon.

7 In 1937, the Director of the U.S. National Park Service appointed a committee to investigate the park potential of the North Cascades. Frank A. Kittridge, regional director of the Park Service, headquartered in San Francisco, was active in this effort.

8 The Olympic National Park was established by President Roosevelt under the Act of June 29, 1938, containing the lion's share of the Mount Olympus Primitive Area, which had been established on the Olympic National Forest in 1935. The Act of June 29, 1938, also authorized the President to make additions to the park from adjoining National Forest lands. By proclamation, President Roosevelt made additions to the park on January 2, 1940, and May 29, 1943. Walter H. Horning, formerly on the forest faculty of the Iowa State College, Ames, Iowa, and insure adequacy of raw material but also contribute to control of the problem of overproduction during flush markets for timber products.

Several legislative proposals for taxation reforms were considered by the State legislatures of the two States, but none were enacted into law. However, one significant legislative measure was enacted in Washington in 1939. It authorized management of State-owned forest lands as sustained yield forest management units in cooperation with intermingled private and public lands.

In the private sector of the economy, there were signs that some forward-looking timber products companies were acquiring forest lands to build up their holdings in contemplation of continuous production of timber crops. Also, there were definite indications by the end of 1939 that the lumber market was strengthening. For example, lumber production in the Pacific Northwest dropped precipitously from 12.0 billion board feet in 1929 to 3.9 billion board feet in 1932; thereafter, it increased slowly but steadily to 9.0 billion board feet in 1937, falling again during the recession year, 1938, to 7.1 billion board feet. A year later, it climbed back to 9.0 billion board feet as the economic recovery process resumed. There were strong reasons to believe that, encour-aged by the improved domestic economy, many in the timber industry had recognized the necessity of an overall policy of "sustained yield management' of the region's timber resource. Experience with Article X of the NRA Lumber Code demonstrated the opportunities in a voluntary program of industrial forestry. It was reasoned that this program would not only stabilize private forest-land ownership an insure adequacy of raw material but also contribute to control of the problem of overproduction during flush markets for timber products.

In 1934, the Joint Committee on Forest Conservation had been organized and financed by the West Coast Lumbermen's Association and the Pacific Northwest Association.[9] By the late 1930's, this organization was making substantial progress in promoting private forestry activities. Warren Tilton, a graduate forester, was the chief forester for the committee as a full-time employee. Not long after the founding, William D. Hagenstein was added to the staff.

One of the prime movers in the organization of the Joint Committee on Forest Conservation was Edward Stamm, at that time in charge of logging operations for Crown Zellerbach Corp. and a strong supporter of forest research.

An interesting and significant development in private forest-land management was the program of forest-land acquisition this company had commenced in the late twenties and which continued into the thirties. Purchases were made through Mason and Stevens (later, Mason, Bruce, and Girard) in the name of the Bank of California, Trustee, and were concentrated in the coastal fog belt of northwest Oregon and southwest Washington. Very probably most of the properties, which were of varying size, were in distress if not actually tax delinquent. However, none of the properties are believed to have actually reverted to the counties before purchase. At that time, the company was oriented to sulfite pulp and newsprint production and was interested in the high-site spruce-hemlock lands. This company operated one of the earliest, if not the first, privately owned forest conifer nurseries in the Pacific Northwest at the confluence of the Tualatin and Willamette Rivers near Oregon City.[10] In addition to spruce and hemlock planting stock, the nursery produced some true firs and Port-Orford-cedar for experimental planting of the acquired lands. Port-Orford-cedar, noble fir, and the white firs were tried in competition with the indigenous species, but none could equal the western hemlock and Sitka spruce in growth. The company had also experimented with the cottonwoods at other locations. The Station silviculturists followed these programs with interest and furnished advice.

Important contributors to the accomplishments of the Station have been the seasonal research assistants employed under several titles. This was particularly true during the early years of the Station's history when regular professional appointments were difficult to finance. The emergency programs provided the ways and

9 Warren Tilton died in 1947 and was succeeded by "Bill" Hagenstein as chief forester. in 1949, under Hagenstein's leadership, this body was reorganized as an independent group named the Industrial Forestry Association.

10 At that time, the company operated as the Crown Willamette Paper Co., which later was incorporated into the larger organization, the Crown Zellerbach Corp. Herman Grossman, a graduate forester from the University of Michigan, was in charge of the nursery and planting program.

means of hiring comparatively large crews of such people. Some of these men were employed on a yearlong basis (with no assurance of tenure); others, seasonally; some were graduate foresters; and others, undergraduate students. Mention should be made of some by reason of the nature of services rendered and others owing to later professional accomplishments in private or public forestry activities. Examples not previously named are Junior Foresters Theodore Kachin and Douglass Welch, who were first employed in 1938 and who added greatly to the thinning and pruning studies over a period of several years. Another example was the employment of Morten J. Lauridsen and Paul F. Liniger, who worked as field assistants on forest survey crews for several years commencing in 1939. After leaving the Station, Lauridsen joined the Timber Tax Section of the Internal Revenue Service and later was in charge of this work in the Pacific Northwest. After Liniger left the Station, he first worked for a forest consultant firm; later, he was employed by the Industrial Forestry Association as a forest taxation staff man. His knowledge and experience in forest taxation gained him an appointment by the Governor to the Oregon State Tax Commission, serving for many years until retirement in 1972.

The rise of Hitler and the Nazi doctrine of geopolotik, followed by outbreak of hostilities in Europe, called worldwide attention to natural resources and their place in foreign policy and national defense. The United States, with its wealth of natural resources and industrial development, was in a strong national defensive position. On the other hand, it was seen by other nations as a source of vital supplies or an object of envy and target of aggression. The consequences were inevitable as the “winds of war” blew hot.

By 1940, serious attention was being given nationwide to taking stock of the strength of our national defense position. In the Pacific Northwest, plans were made to analyze the role of forest and range land resources and plan for their effective use in the defense program.

Nearly every year since the Station was established, visitors from this region, other forest regions in the United States, and from abroad came to Portland to learn of the Station’s work in the office and field. The year 1940 had its usual quota or more, including a number of foreign visitors. Ordinarily, this would not appear unusual, but in view of the European political climate, a few drew special attention. Dr. Adelbert Ebner, a German forester, spent some time in the Pacific Northwest, ostensibly representing the German Library of Information[11] in New York City, which was reputed to be a part of the Nazi propaganda organization. He showed an unusual interest in the forest survey type maps of Oregon and Washington and requested copies. Acting upon instructions, the Station told him they would be mailed to him at New York. His request was sent on to the Washington Office for action there. Another cloak and dagger event was the appearance of two Finnish foresters whose names and actions seemed to arouse suspicion that their background was more German than Finnish. They left Portland to travel leisurely down the Oregon coast for California by private auto, reportedly under surveillance of the FBI, who occupied neighboring offices to the Station on the fourth floor of the Federal Courthouse in Portland.

In 1935, the Station adopted the policy of issuing annual reports for public distribution. For many years prior to that, it prepared a simple factual accounting annually of the Station’s activities. This was typed and a copy sent to the Washington Office in company with copies of the project status sheets, which had been mimeographed for in-Service use.

The public report was less technical and selective in content, emphasizing the important progress in the Station’s program and explaining how this was helping solve regional forest problems. A limited edition was mimeographed and distributed to forest schools, other public and private forest agencies, and cooperators. It was bound in a plain cover. The only illustration used was an appropriate photograph on the cover.

Director Wyckoff, after appraising the reception of the public report and the depth of the demand for copies, decided to “dress” it up. The foreword was expanded to explain the nature of the region’s forest resource and its relation to the region’s economy and social life. It explored in greater depth the objective and philosophy of the

11 Recalled from memory of the author and confirmed by P.A. Briegleb.

Station's program. The 1938 report, issued in 1939, was a modest beginning. Commencing with the 1939 report, a few simple pie charts and graphs were included in the test. At this time, Director Wyckoff had delegated to Lodewick and Cowlin the task of assembling the material from the several divisions and improving the format. This proceeded gingerly, since the Government Printing Office objected to publication by Federal field offices that used type or resembled printing or otherwise infringed on their domain. In a show of venture laced with defiance, the 1940 Annual Report sported a colored cover. A few more charts were added, all in black and white. The Director prepared the text of the introduction or foreword, calling upon the division chiefs for suggestions and supporting information. The opening paragraph of the 1940 Annual Report is an example:

During 1940 the tempo of public thought regarding forestry definitely quickened in the Pacific Northwest. The hearings of the Joint Congressional Committee, the Pierce acquisition bill, the well-known letters from Secretary Wallace on the forest problems of the region, the work of the Forestry Committee of the Oregon Economic Council, the public fire protection campaigns in Oregon and Washington, and the convening of the Oregon and Washington legislatures have been among the more important causes.

The following paragraph cited "regulation of cutting on private lands" as one of the several problems and solutions that were the subject of public controversy.

Although the JCC report was not published until a year later, the hearings had raised the specter of Federal regulation in the minds of the timber industry. There were some in the industry who favored Federal acquisition of distress old-growth timberlands in private ownership. Congressman Walter Pierce, who represented eastern Oregon introduced legislation that would authorize a substantial program of Federal acquisition of forest land to be financed by issuance of Treasury bonds which presumably would be self-liquidating. Tucked away in the body of the Station's annual report was a short paragraph calling attention to "the acute timber supply situation in the Klamath Plateau and Deschutes River units." In 1941, in the public address in Klamath Falls, Regional Forester Watts called attention to the problem in that town and likened the solution to a three-cornered stool, which would not stand unless all three legs were in place and firm. The trio was Federal cooperation and financial assistance for forestry practices on State and private lands, public acquisition of forest lands not suitable for private ownership, and Federal regulation of cutting practices on private lands. This talk and a similar address in Bend about the same time drew considerable fire from timber industry spokesmen. sit also attracted public attention to some chronic problems in the relation of timber supply to industrial capacity. Watts bluntly predicted that sawmill capacities in these two towns would have to be greatly reduced if they were to remain in continuous production. This prediction came true but not as soon as anticipated.

Chief Forester Silcox[12] and Associate Chief Forester Clapp were strong supporters of Federal forest regulation. The political climate was highly favorable at this time to this policy. The policies and programs of the New Deal administration had led to a great extension of Federal regulation of private enterprise and business conduct. The Congress, with the President's urging, had created the National Labor Relations Board, the Securities and Exchange Commission, the Federal Power Commission, and the Federal Communications Commission as permanent governmental agencies. Armed with regulatory authority and staffed with vigorous and aggressive federalists, these agencies imposed many changes on industrial, business, and banking practices. Social security legislation was another facet of this changing order. Federal taxes were increased to support this program. Federal support was given agriculture in many ways, and other agencies were established to implement aid to the farmer. The rise of labor unions and farm organizations in political power insured continuance and growth of these programs. These political and economic phenomena were a natural consequence of the trauma on the American public of the sudden onset of the Depression and lack of response by the traditional form of American business and finance organizations to meet the problem. In retrospect, it would seem that this was the ideal time for legislation to enforce Federal regulation of the timber industry with its past history characterized in the media by

12 F. A. Silcox died December 20, 1939, from a heart seizure. Appointed Chief of the Forest Service November 15, 1933, he gave dynamic leadership to the Forest Service during a difficult period and strengthened the societal objectives of public forest management.

conservation writers as “cut out and get out.” Perhaps the timing was a year or two late since World War II altered the situation. The introduction of the 1940 Annual Report of the Station also called attention to the national defense program now getting underway and its prospective impact upon forestry considerations.

Owing to the expiration of the appointments of all members of the Advisory Council January 1, 1940, no meeting was held during the year. Requests for renewal of appointment of those willing and able to serve and the names of six new prospective members were submitted to Washington, but official notices of appointment did not reach the Station and the committee members from the Secretary’s office until late in the year.

The year 1940 was eventful in other respects. Several projects resulted in major publications and others produced progress reports. In other cases, research results were used in conferences to plan changes in forest practices for the better. Work was strengthened in several fields of study that had previously been at a minimal level.

On the other hand, the Station suffered losses from personnel changes. On April 1, E. L. Kolbe transferred to a flood control position at the California Station. Later in the year, Brandstrom accepted a position in the forestry department of the Crown Zellerbach Paper Co. However, he was headquartered at Portland, and the Station placed him in a was. (when actually employed) status, thus obtaining his part-time services to complete some unfinished final reports.

These losses were the result of fiscal stringencies in regular funds. Forest Management allotments were several thousand dollars less than previous years and were inadequate to carry all members of the staff after Munger occupied the position of Division Chief. Briegleb was paid from Forest Management funds for 6 months only; the forest survey paid his salary and expenses for the remainder of the year. Matthews and Morris completed the regular professional staff of this division and cost of carrying them was assisted by an allotment of FFC (forest fire cooperation) money.

Partly offsetting these setbacks, the Regional Office continued to finance salaries of four CCC technical foresters; Kachin, working from the Portland office, and three assistants to technicians, assigned to the three active Experimental Forests as CCC crew foremen. In addition, a WPA white-collar project added 15 office workers to the Portland force where they were constructively employed on necessary but routine clerical jobs and map drafting and hand-coloring.

Initiation of work on the Walla Walla watershed survey, accompanied by increased flood control funds, permitted the addition of Wallace R. Robinson, Chandler V. Jensen, and Donald R. Peters to the staff. These men were recruited from National Forest Administration, and when flood control surveys ended they returned to administrative work.

Among the significant accomplishments of the Forest Management staff in 1940 was help given the Regional Office. At the Regional Forester’s request, the Station staff conducted several field conferences with administrative personnel on partial cutting practices in the Douglas-fir region. The Station also prepared a set of instructions for timber cutting practices on National Forest timber sales.

In order to maintain effective communication between the two offices, Brundage for the Region and Cowlin for the Station had been named by the Regional Forester and Director to act as liaison officers to improve communication and expedite action on relevant matters between the two offices. As it happened, this arrangement lasted only a few years as it was not used often because harmony prevailed naturally.

The loss of Kolbe after 12 years of service not only slowed down pine silviculture studies but also had an impact on other forest management studies. He was always willing to take on additional assignments and tackled the routine and tedious jobs with the same enthusiasm given major projects. He gave leadership to the phenology project and the endrology and arboretum projects. The principal forest management project carried on in the pine region during 1940 was Briegleb’s growth studies. Remeasurement of sample plots was producing a better

knowledge of mortality and net growth as well as gross growth. Analysis of these data was directed toward determining the probability of mortality and growth for each ponderosa pine tree class. The Station was using Keen's tree classes and increment core measurements of some 8,000 trees made by the Forest Insect Laboratory in this analysis.

Isaac's seed studies continued to yield important findings. He extended his studies of viability of seed to other conifers than Douglas-fir and confirmed his previous conclusion that Douglas-fir seed germinated or lost viability within a year after falling to the forest floor. Western hemlock, western redcedar, noble fir, Sitka spruce, and ponderosa pine performed like Douglas-fir, germinating the first spring but not after. Western white pine and Port-Orford-cedar were exceptions to this finding, showing some germination in later years. Isaac's study of tree losses in Douglas-fir following cutting indicated that residual trees suffered heavy mortality from windfall and other causes and that two seed trees per acre were generally inadequate.

Isaac's report, "Vegetative Succession Following Logging in the Douglas-Fir Region With Special Reference To Fire," published in the September 1940 issue of the Journal of Forestry, was a primary contribution to the forest ecology literature of this region. For the first time in the literature, the weed-brush stage of plant succession that occurs in establishing a new forest crop was described. Isaac also found some exotic species were appearing in some parts of the region. For example, Australian fireweed, a herbaceous plant, was found invading large areas of cutover land on the southern Oregon coast. More widespread invasion of Scotch broom, gorse, and evergreen blackberry were also noted.

A prosaic but useful conclusion was reached in the Douglas-fir pruning studies. It was found that the Hebo club was more efficient than the pole pruning saw. This method made climbing and pruning to a desired height practical. To minimize potential damage from using the conventional long spur climbers, a multiple-spur climber with five short spurs was designed and tried. It appeared to not only lessen damage but also made climbing easier for the user.

The results of the Snohomish County study by Matthews and Morris of fire control on private lands were published as a Station report late in October 1940. It presented an analysis of adequate fire control in two parts. First, it gave a detailed account of fire history, fire occurrence, ownership, land use, forest cover types, protective organization, time elements of fire control, costs, source of funds, and the impact of fire on forest growth and depletion. The second section developed specifications and costs of adequate forest fire control and outlined responsibilities for action and support of the proposed program.

A high point in the range management program was the official establishment, on July 11, 1940, of the Starkey Experimental Range as a center of future cattle management research. To prepare for future work, a utilization survey of the area was made, a forage map of the area was prepared using data from the 1939 range survey, and boundary fencing and spring water development commenced.

The Division of Range Management cooperated with the Regional Office and the Oregon Agricultural Experiment Station in preparing a plan for a joint study by Oregon State College and the Forest Service on the Bull Run Allotment of the Whitman National Forest. The study included a range survey and a utilization survey of the allotment.

The Division of Forest Products Research contributed to the national defense program by making a survey of the current production of aero grades of Sitka spruce. This country and the United Kingdom were making heavy demands upon the sawmills manufacturing spruce lumber for this prize species. Specifications were rigid, particularly those of our Government, and only a small percentage of spruce lumber cut would pass muster. The forest survey staff made estimated of the supply of Sitka spruce stumpage available for sawmills cutting aero stock.

Softwood timber products were especially suitable for military needs, and the Pacific Northwest was a major supplier. As a result of our expanding defense program and export demand, production of lumber, plywood, and wood pulp was increasing and questions concerning adequacy of available stumpage for manufacture of select items were raised. The Forest Products staff gave increasing attention to the utilization of western hemlock and the balsam firs. A preliminary survey was made of the use of these species in plywood manufacture in cooperation with the Madison Laboratory and the Douglas Fir Plywood Association. Peeler grade logs of hemlock, noble fir, and Pacific silver fir were processed in several plywood plants and records made of yields, veneer quality, and other factors of suitability. Brandstrom and Lodewick represented the Station in following these tests and appraising the results.

Fieldwork on the first of a series of Douglas-fir lumber grade recovery studies was completed at a Willamette valley sawmill. In addition to the usual cooperation agencies on these projects, the O&C Land Grant Administration (later the Bureau of Land Management) participated.

Two check studies were made to compare the Pacific Northwest log grades and the recently developed inter-regional log grades. Under Region 6 conditions, the interregional grades did not prove as satisfactory as the older Pacific Northwest grades.

Johnson prepared a series of four articles on farm woodland which were published in the Farm, Home, and Garden Section of the Sunday issues of The Morning Oregonian. The articles discussed timber as a source of farm revenue and described management and marketing methods and problems.

The forest survey section continued the reinventory program of the Douglas-fir region at the rate of about six counties a year. County statistical reports were being issued and distributed within about 6 months' time after completion of the fieldwork.

The year 1940 was a big one for major forest survey publications. "Forest Resources of the Douglas-Fir Region," U.S.D.A. Misc. Pub. 389, by Andrews and Cowlin, was published in December of that year. This was the first of the comprehensive regional reports issued by the nationwide forest survey. A State report, "Forest Resources of Washington," by Cowlin and Moravets, was printed and distributed by the Division of Forestry, Washington Department of Natural Resources. Briegleb's "Forest Growth in the Ponderosa Pine Region of Oregon and Washington" was issued June 1940 as the Station's Forest Survey Report No. 78. It was issued as a multigraphed paper to expedite dissemination of this information, which was very timely in view of the public concern for the future growth prospects to supply the pine timber industry in this region. This was to be followed by a comprehensive regional report. The manuscript, entitled "The Ponderosa Pine Region of Oregon and Washington," by Cowlin, Briegleb, and Moravets, was in final form and was transmitted late in the year to the Washington Office for review and approval for printing. However, this report was fated to be edited in Washington, and a year or two was required to respond to editorial questions and changes, galley proof and page proof review, and making necessary corrections. From the time since the forest survey was initiated, the Station had followed a policy of using technical journals, trade journals, public addresses, and the press to distribute information on survey methodology, preliminary findings, and selected items of current interest. This policy and internal Forest Service use of forest survey data and conclusions drawn from them gave wide currency to up-to-date information on the forest resources of the Pacific Northwest.

For a year or more, Wilson had been preparing the new public domain report. As work progressed, it became evident that to publish this work in a single report would result in an extremely weighty volume. Accordingly, Wilson reorganized the report outline to provide for a series of progress reports, each a complete unit of information. This series would be followed by a condensed comprehensive report. This plan would preserve the detailed analysis for interested users and provide an overall analysis for those interested in the broader aspects of the problem.

Demands upon Wilson's time from the many land-planning and taxation-oriented agencies continued without letup, delaying completion of his report writing. From his studies, Wilson had concluded that overappraisal was an important cause of the breakdown in private forest-land ownership. He applied this rule to appraisal for most purposes; acquisition, credit, taxation, differentiating land uses, and land management. He attributed overappraisal to an inherent tendency for treating parts of the whole as independent subjects in which the sum of the parts invariably exceeded the whole.

Like Wilson, DeVries was called upon to attend many meetings and supply information on forest taxation methods and reforms to a number of groups and agencies. However, he completed a report entitled "Rural Tax Rates For 1940 in Oregon and Washington Counties," which was multigraphed and distributed as "Studies in Forest Land Economics. Report No. 3."

From his studies of local government reorganization, DeVries concluded that long-term management of private forest land for continuous production was particularly handicapped by uncertainty, variability, and fluctuation in district (usually school or road) tax rates. He also found that certain forest properties were inherently discriminated against. These properties were nonoperating old-growth forests and second-growth forest which had an excess of younger age classes.

Publication of a Station annual report was suspended commencing with the 1941 issue until the end of World War II. However, this was not the only casualty suffered by the Station. A memorandum issued by Secretary of Agriculture Wallace directed that national defense measures should be given first priority, followed by postwar planning with the regular work program in third place.[13]

By the end of 1940, there was concern that the Douglas-fir lumber industry might face problems in meeting increased demands for construction lumber and other critical timber products vital to the defense program. Shortage of certain key supply items needed in the logging and timber manufacturing industries were beginning to appear or were anticipated. Critical labor problems were also developing. Unions had been gaining in strength with the return of prosperity to the timber industry and were striking for higher wages. Both the American Federation of Labor and the Congress of Industrial Organizations were represented in the industry with consequential rivalry in gaining advantageous settlements and jurisdictional disputes.

In view of these conditions, the Council of National Defense, through the Bureau of Research and Statistics of the Council's Advisory Commission, initiated a fact-finding survey of the economic performance of the industry. Stacy Nay. Director of the Bureau, recruited Dr. Dexter M. Keezer, president of Reed College, as a consultant to conduct the investigation and requested the Station to assist in the study. Before this study was completed. it involved many government agencies, a number of timber operators, labor unions, and several faculty individuals who possessed special information or skills. The study included information on the following subjects:

1. Relationship of production, sales, prices, and wages in the Douglas-fir lumber industry
2. Financial history of the industry
3. Employment and payrolls
4. Wages
5. Douglas-fir lumber prices and competition factors with southern pine lumber
6. Estimated military and civilian requirements of lumber in 1941 and 1942

13 This policy would seem to reflect the belief in Washington that direct involvement of the United States in the war was inevitable.

7. Rail and water transportation costs
8. Labor productivity

The following federal agencies furnished information and assistance: the Tariff Commission, the Bureau of Labor Statistics, the Internal Revenue Service, the Census Bureau, the Wage and Hour Division of the Department of Labor, the Reconstruction Finance Corporation, the Interstate Commerce Commission, the Maritime Commission, and the Forest Service.

The West Coast Lumbermen's Association and other industry groups and concerns provided information and cooperation in the study. Also cooperating were the Lumber and Sawmill Workers Union, A.F.L., and the International Woodworkers of America, C.I.O. Pertinent economic information on costs, returns, and profits was obtained by questionnaire and interview of some 80 timber products manufacturers and logging operators, including practically all of the major concerns in the region.

Collection of information started in December 1940 and by the middle of March 1941 the data were collected, analyzed, and a report prepared and reproduced for distribution to interested agencies and individuals. The reason for urgency in completing this study was the expiration in March 1941 of a 3-month agreement on wage rates. This agreement, reached at the end of 1940 following a strike involving a large segment of the timber industries, stipulated that such a study should be made of the economic performance of the industry which would be acceptable as reliable by both industry and labor.

Under the direction of Dr. Keezer, analysis of the data and report preparation was chiefly done by Dr. Norman Burns, principal economist of the Bureau of Research and Statistics; Advisory Commission to the Council of National Defense; A. L. Morgan, assistant to the Chief of the Accounting Division of the Tariff Commission; and Paul E. Warwick of the Bureau of Labor Statistics. Dr. B. O. Wheeler, then in the Department of Economics, Oregon State College, and Dr. Frank Munk of Reed College contributed specialized portions of the analysis and report.

Herculean labors were needed to meet the deadline for completion of the report and distribution to industry and labor. Long hours, including nights and weekends, were spent on this job. The Station furnished technical data and review, office space and equipment, and computer and stenographic help, and handled the mechanics of processing and distributing the report. Lodewick, Johnson, Cowlin, Moravets, and several of the clerical staff devoted a major part of their time to the project.

A short time after the report was published and distributed, two meetings were held at Olympia, Wash., under the aegis of Governor Arthur Langlie to present the report and answer questions relating to its content but refuse questions on matters of policy. The meetings, held March 18 and 26, were attended by leading representatives of industry and labor, a few State officials, representatives of the U.S. Conciliation Service, U.S. Department of Labor, and Director Wyckoff and Cowlin from the Station in addition to Dr. Keezer who presided, assisted by Burns and Morgan who fielded questions regarding the data presented in the report.

Regardless of the fact that this report provided economic data not previously available on an industry-wide basis, conciliatory efforts of the National Defense Mediation Board could not make a constructive settlement of the issues in dispute. Lack of uniformity in the industry's working conditions and wage schedules, uncertainties regarding various segments of the industry, and variance in testimony received from disputing parties demonstrated the need for further investigations and judicial decisions. Accordingly, later in the year the Board created a panel of the West Coast Lumber Commission[14] to function in this manner. It was composed of three members: Dr. Keezer, chairman; Wayne Morse,[15] dean of the University of Oregon law school; and Dr. Paul Eliel, dean of the Graduate

14 This name was given to the commission later when the War Labor Board was established.
15 Later, a U.S. Senator from Oregon.

School of Business Administration, Leland Stanford, Jr., University. It was headquartered in Portland and had a small staff occupying rented quarters. The commission was directed by the Board to make an "impartial study of the Douglas-fir lumber industry which would disclose among other things the general condition of the industry." The commission was also directed to make specific recommendations regarding issues involved in a specific labor dispute in the Puget Sound area involving some 12,000 workers.

Again the Station was called upon for help in this followup study. Significant changes had occurred in economic conditions since the earlier study was made which demanded collection and analysis of new data. As was done before, A. L. Morgan and an assistant gathered information on the financial record of the industry. Information on all other aspects of the report was assembled by Cowlin whose time was contributed. He and Morgan prepared the report with a foreword and summary statement by Dr. Keezer. Station personnel did the clerical and stenographic work and processed and distributed the report November 1, 1941. Recipients of the report were invited to submit any questions and suggestions in writing for answer or incorporation in an appendix.

Station costs for both these studies were paid from regular funds. With the exception of a small amount of ERA money, a small-scale WPA "white collar" project, and a few CCC-financed workers at the Experimental Forests, no emergency funds were available to finance work done on assigned defense projects and postwar planning activities. No changes in the roster of regular personnel occurred during 1941.

Requests for miscellaneous defense-related information and increased attention to postwar planning forced the Divisions of Forest Products and Forest Economics (including the forest survey) to severely curtail work on regular projects. However, these two divisions were able to undertake jointly a comprehensive economic study of the Grays Harbor Unit (Grays Harbor, Pacific, and western Jefferson Counties). This project was a departure from previous resource studies and was designed to supply information on the forest-land resource, its characteristics and use, dependent industries, and recommendations for future management for a homogeneous unit larger than a county but more localized than the Douglas-fir region or sub-State such as western Washington.

Although Forest Management Research members were relatively free to work on regular study programs, they were hampered by inadequate seasonal and subprofessional help. Partial cutting in the Douglas-fir region continued to be the major silvicultural project. Because of lack of available personnel, expansion of the field studies was limited to what volunteer help Isaac got from National Forest officers. Limitations to partial cutting were becoming known but definitions were needed of conditions for application on public lands considering the complexity of silvical and economic factors. Munger and Isaac assisted in formulating a set of cutting principles for the National Forest timber management handbook, covering a dozen or more distinct variations in stand structure occurring within the region. The Station also assisted in drawing up suggested rules for regulating cutting on private forest lands in both the fir and pine regions.

Interest was developing in utilization of western hemlock for production of lumber as well as pulp. For example, the West Coast Lumbermen's Association requested that the Station make a hemlock grade recovery study in advance of completing the series of cooperative studies underway at Douglas-fir sawmills. Higher prices for hemlock lumber stimulated this interest which led to better balanced forest utilization in the mixed stands of the fir region. Publication of an article by Briegleb in the May 1941 issue of Pacific Pulp and Paper Industry, giving results of growth measurement on spruce hemlock stands at Cascade Head, called attention to the phenomenal yields of this type. Although oriented to the pulp industry, the article also emphasized the intrinsic values of these species and the opportunity for integrated intensive forest protection and management. Publication of U.S.D.A. Circular 586, January 1941, "Slash Disposal and Forest Management After Clear Cutting in the Douglas-Fir Region," by Munger and Matthews, called attention to the difficult fire control problems on the increasing area of cutover lands. On the plus side, the principles expounded in the Snohomish County study of adequate fire control on private lands were beginning to be applied in a practical way. Field and office work was completed on the comparison study of the Clackamas-Marion County fire protection district by Matthews and Morris, and preparation of the report was commenced.

The recently developed Keep Oregon Green and Keep Washington Green organizations and campaigns were beginning to make progress in educating the public to the forest fire problem and its implications to the region as a whole.

Planting programs on private forest lands were revealing the need for strengthening forestation research. During 1941, the Weyerhaeuser Timber Co. established the Clemons Tree Farm on their cutover holdings in the Grays Harbor area. In western Oregon, a similar undertaking was in the process of being organized and incorporated as the Willamette Valley Tree Farms. Several companies were involved in this organization. The West Coast Lumbermen's Association, under the leadership of Colonel Greeley, established a 5-million-seedling-capacity nursery at Nisqually in western Washington to help supply these increased planting programs.

Upon the urging of Munger, a comprehensive bulletin on artificial reforestation in the Pacific Northwest was being prepared by J. F. Kümmel of the Regional Office of Timber Management. Kümmel had accumulated a wealth of information and experience on this subject, commencing in 1908 when he joined the Forest Service in Portland.

Some of the larger, well-entrenched timber companies in the fir region were acquiring cutover lands bearing second-growth stands, usually in small parcels scattered through their own properties. Also, an increasing number of professional foresters were being employed by such companies. They were used in several capacities and phases of the operation. More attention was being accorded the planning of logging operations to leave cutover lands in better condition and improve prospects for natural regeneration.

However, this improvement of forest practices was by no means universal in the fir region. Many operators were liquidating their timber holdings rapidly as prices were high, particularly for selected high-grade lumber items sorely needed in the defense program. This was stimulating high-grading and zero margin cutting practices with resulting lowering of wood utilization.

Progress in industrial forestry in the pine region was less promising in some respects at this time. On the other hand, standard logging practices in this region customarily had left the land in better condition than in the fir region. The land exchange policy of the Forest Service, in effect at this time, was a stabilizing influence on the industry and encouraged operators to practice lighter selective cutting, leaving a residual stand of relatively high growth potential.

Experiments in sanitation salvage cutting by private operators as a pine beetle control measure was also a significant sign of progress in private forestry. This method originated from experiments by the California Forest Experiment Station at the Black Mountain Experimental Forest in northern California. This work was done in cooperation with the Bureau of Entomology and Plant Quarantine. With the cooperation and advice of Paul Keen, this practice was being developed commercially on private forests in the Klamath Falls area.

Ample rainfall in 1941 in the pine region favored forest and range growing conditions. Previous years had been generally in a dry cycle. This weather phenomenon had created an anomalous condition on rangelands of central and eastern Oregon and Washington. Ranges, which for several years had appeared to have little or no forage, were green by the summer of 1941. However, on many areas, much of the current growth was in grasses low in palatability and nutrients. The desirable species, long overgrazed, were slower in recovery. This condition threatened to encourage overgrazing, particularly in view of peak demands for livestock production to meet war emergency needs. The Division of Range Research responded by intensifying dissemination of information on practical range improvement measures and simple indicators for appraising range productivity and condition.

Early in 1941, flood control work in the Department of Agriculture was reorganized by the Secretary. Prior to this time, three Bureaus—the Bureau of Agricultural Economics, the Soil Conservation Service, and the Forest Service—divided responsibility for work on each watershed under study. Under the new system, the BAE was responsible for carrying out preliminary examinations of watersheds assigned for study. This left the SCS and Forest Service to work under supervision and direction of the BAE on the preliminary examinations. This resulted

in halting all flood control work at the Station effective March 15, since the Walla Walla detailed survey was being done by the SCS and all work on preliminary examinations was transferred to the BAE. Unexpended flood control funds at the Station were withdrawn effective April 15. This dictated some shuffling of personnel in order to avoid sudden reductions in force. As it happened, Raymond H. Chapler had been on sick leave since April 2, 1941, and was in the process of retiring for disability.

Late in June 1941, the reestablished Station's advisory council held a combined field trip and meeting in the northwest coastal area of Oregon. During the course of a 2-day itinerant meeting, the tests of seeding of cutover lands to convert such lands to permanent pasture were viewed at the Northrop Creek Experimental Grazing Area,[16] and the Mount Hebo plantations on the Siuslaw National Forest and the second-growth, spruce-hemlock, growth-and-yield plots on Cascade Head Experimental Forest were inspected.

Early in 1942, work of the Station was put on a wartime basis. The work week was increased from 40 hours to 48 hours, and defense projects underway at the close of 1940 were converted to wartime conditions. During the year, about 25 percent of the Station's work was employed directly upon war jobs assigned to it by the War Production Board or the War Labor Board. In addition, work on the going regular projects was reoriented to assist the war effort more directly. It was estimated that 85 percent of the Station's effort was engaged on war programs, either directly or indirectly.

The Office of Emergency Management allotted $21,000 to finance salaries and expenses of Station people working directly on studies assigned to the Station by the War Production Board. Later in the year, the War Labor Board allotted $10,000 to the Station for labor studies of the Douglas-fir lumber industry, which was still beset by labor problems.

Despite these added emergency funds, some personnel changes had to be made, since the Flood Control survey funds had been withdrawn and the Forest Economics funds had been suspended at the beginning of fiscal year 1943. Raymond Chapler retired for disability and W. H. Bolles transferred to National Forest Administration in February 1942, eliminating the Flood Control staff from the Station's roster. Brandstrom, who had been under w.a.e. appointment since late 1940, officially resigned in February 1942. E. D. Buell of the forest survey staff resigned on July 31 to engage in dairy farming. However, the forest survey group was bolstered during the year by the transfer of George E. Morrill from the Appalachian Station and George S. Meagher from the Southwestern Station. Both of these men had previously worked for the Station, Morrill as a field assistant and Meagher as a junior forester. P. A. Briegleb was on leave for 4 months to teach forest mensuration at the University of California Forest School during the spring semester. On May 16, Donald Matthews was detailed to the Regional Office on an indefinite basis to assist in the forest fire emergency program.

A number of the younger men, who had been employed seasonally on Station regular projects and on emergency-financed yearlong projects during previous years, were called for military service.

With the greater demand for manpower in war-related activities, white collar projects of the WPA and the CCC projects on the Experimental Forests were terminated. This limited work at these field stations to essential maintenance work and a minimal amount of study plot remeasurements.

The war projects undertaken by the Station were designed to supply information on specific problems that were adversely affecting production of forest products essential to the overall war effort.

Shortage of many critical items and the need for allocation of available supplies to optimum use and the necessity for control of prices led to the establishment of the Office of Price Administration (OPA) with an administrator and staff in each State. The first major wartime project assigned to the Station was a comprehensive study of the tire

16 Operated cooperatively by the Oregon State Agricultural Experiment Station and Clatsop County on tax-reverted lands.

requirements of the Oregon logging and lumber industry. The control of rubber-producing areas in Asia by the Japanese and the submarine warfare by Germany interfering with flow of raw rubber supplies from other parts of the world put rubber high on the list of critical items. This situation was aggravated by the rapid development in recent years of truck logging. In addition, other rubber-tired vehicles were also in use in the timber industry. This study was conducted by questionnaire and field followup interviews. Familiarity of Forest Products and forest survey personnel with the timber industry, its operating methods and problems, and acquaintance with key people in the industry facilitated this study and others following. Four other studies of lesser extent than the tire study were made of equipment and material problems. One of these was a study of the use of lumber carriers and straddle trucks in the sawmill industry of the region. Other studies included use of power saws for felling and bucking, survey of number and type of extra-heavy-duty trucks used in the Pacific Northwest logging industry, and reasons for their replacement of standard equipment, and, finally, the quantity of binding wire used on interstate carload shipments of poles and piling was determined for 1941.

The Division of Forest Products made a canvass of number, capacity, and use of dry kilns at all sawmills and remanufacturing plants in the region. Statistical reports normally made of the industry by the division were expanded greatly to cover production shipments and stocks of lumber. The shipments of Douglas-fir pontoon lumber, ship decking, and marginal plank were compiled and reported monthly. Shipments of aero grade spruce were also reported monthly; and in addition to the statistical data, Lodewick prepared an accompanying qualitative report on problems and progress of individual plants in producing this critical item. This information was gathered by a monthly visit to each plant. Scarcity of spruce dictated use of substitute species—noble fir, western hemlock, and Douglas-fir—under rigid specifications. Jim Girard, then on the Washington Office staff, made special studies and spot inspections of aero lumber use and production. Late in 1941, a barometer-type report of production of all grades of lumber by species was commenced for the Douglas-fir lumber industry. The West Coast Lumbermen's Association barometer reports were used as a base supplemented by data collected by the Station from non-member mills to make an integrated report. Monthly reports on production of plywood were also made, which included information on present or prospective bottlenecks in production arising from scarcity of equipment and supplies, including peeler logs.

To provide information on the supply of raw materials for the timber manufacturers, the Station collected and compiled a series of periodic reports which were furnished the War Production Board and related agencies. Monthly reports on log inventories in the Columbia River, Puget Sound, and Grays Harbor areas was one of the series. A more comprehensive analysis was made on a quarterly basis of the factors affecting production, which analyzed and evaluated the factors impeding optimum production of lumber and other timber products. One of the fundamental causes of lag in log production was found to be shortage of manpower. This shortage consisted not only of numbers of workers but noticeable lack of certain essential skills. Other factors were adverse weather, lack of adequate equipment and supplies, shortage of available stumpage, and price problems. These reports were compiled and coordinated by the Station from information received from all parts of the region. One man on each National Forest, usually a member of the supervisor's staff, was assigned responsibility of reporting on conditions on his National Forest and contiguous areas. Station personnel collected information from other sources to supplement the National Forest reports and to cover areas such as southwestern Washington and northwestern Oregon, which were distant from a National Forest.

In addition to these wartime assignments made on a regular reporting basis, the Station was called upon for a number of spot studies of a nonrecurring nature. For example, the number of wooden barrels used for cold-pack fruits produced in the region was determined, a study was made of the sources of Douglas-fir bark for manufacture of cork, and locations were determined where concentrations of hemock bark existed in sufficient quantities for feasible extraction of tannin. The studies were all reported to the war agencies, usually through the Washington Office of the Forest Service but in some cases directly to the requesting agency. The studies were grouped and designated as "Requirements, Products, and Supplies" (RPS) projects.

Establishment of log ceiling prices by the OPA were causing production problems. In addition, the OPA was proposing a ceiling on stumpage prices. The Station made an analysis of the influence of log ceiling prices on production of logs and of the possible effect of stumpage ceilings upon log and lumber production.

A companion to the major problem of price controls was that of wage controls and attendant constraints.

A study of economic conditions in the ponderosa pine industry similar to that made in 1941 of the Douglas-fir industry was made during 1942 by the national War Labor Board. A. L. Morgan of the Tariff Commission conducted this study again, making his headquarters at the Station, which provided basic information and clerical assistance as it had done in the Douglas-fir studies.

Labor problems continued to plague the Douglas-fir industry, and the West Coast Lumber Commission[17] requested that the Station undertake a comprehensive study and analysis of job classification and evaluation of the Douglas-fir logging and lumber industry. Technical assistance and advice was to be made available to the Station by the War Manpower Commission. Accordingly, late in 1942 the Station prepared a working plan and sampling schedule which was submitted to the Budget Bureau for approval.

Despite the heavy obligations of the war projects, the Divisions of Forest Products and Forest Economics were able to complete a creditable amount of progress on regular projects. In many instances, gathering of information on war projects could be integrated with work on regular studies at a saving of time and travel expense.

The Forest Products group completed the analysis and published a report on a study of western hemlock log values and milling costs made late in 1941 at a sawmill on Puget Sound.

Two grade recovery studies of Sitka spruce were made at coastal sawmills, one at Raymond, Wash., and the other at Taft, Oreg. These studies provided information on recovery of all grades, including aero which was a special item. The yield of aero grade cants was 1.7 percent of the total at the Washington mill and 13.0 percent at the Oregon mill, illustrating the importance of locating spruce stumpage suitable for this select item. The forest survey concentrated a major part of their reinventory program in Lane, Lincoln, and Tillamook Counties in western Oregon. The latter two counties and western Lane County were in the vital coastal defense zone and also contained heavy stands of Sitka spruce.

During 1942, work of the Division of Forest Economics, including the forest survey, was consolidated under Cowlin's direction, including overall responsibility for all assigned war projects. Prior to the close of the fiscal year on June 30, 1942,. Wilson completed his report entitled, "The New Public Domain in Western Washington and Western Oregon." Editing and publication was postponed owing to pressure of war activities. During the latter half of the year, Wilson was engaged on various war projects and financed from war emergency funds. DeVries continued studies of various aspects of forest taxes and local government. He began work on an investigation of financial support of comprehensive forest fire protection of private forest lands and of the relative cost burden upon property within current fire protection districts. The financial arrangements for fire protection were found to be varied and complex, partly the result of intermingling of public land with private properties consisting of a few large and many small holdings. The fire protection associations were usually composed of comparatively few large private timber owners. It was concluded that forest fire finance was closely connected with taxation in its effect on economic feasibility and stability of private forest-land ownership. Late in the year, DeVries was detailed to Florida to.work with Ronald Craig of the Southern Station on a study of the effect of forest property taxation upon private forest management in Florida.

17 This agency had been formalized and reorganized following the study of the fir industry made for the panel of three members headed by Dr. Keezer.

Briegleb and Girard completed a field study of new methods of measuring growth in the Douglas-fir region using temporary plots which promised important improvements in the forest survey growth estimates. An article reporting on techniques employed and results obtained was prepared under joint authorship for the Journal of Forestry for publication early in 1943.

Late in the year, U.S.D.A. Misc. Pub. 490, "Forest Resources of the Ponderosa Pine Region of Washington and Oregon," by Cowlin, Briegleb, and Moravets, was printed by the G.P.O. However, copies for public distribution were not received until early 1943. This completed the set of two comprehensive regional reports giving the results of the initial forest survey of the Pacific Northwest forest resources.

Progress in forest management studies was limited to continuing work on partial cutting of Douglas-fir stands and consolidating information on forestation for use of the expanding program of planting of logged-over lands. Munger prepared a field handbook for planting agencies. Kümmel retired from the Forest Service without completing the planned bulletin on reforestation. Actually, little progress had been made on a finished manuscript of the project. In collaboration with Charles Rindt, who succeeded Kümmel in charge of reforestation activities in the Regional Office, Munger took over the task of bringing the report to completion.

Fire studies took on added importance due to the potential hazard to the war effort from incendiary fires by enemy action in the coastal zone. Forest fire smoke from fires developing from normal causes also hampered military operations. Matthews was transferred temporarily to the Regional Office to work on defense measures related to fire detection and suppression. Prior to this move, Matthews and Morris completed the report, "Adequate Forest Fire Control Based on a Study of the Clackamas-Marion Patrol Unit in Oregon," which was published as a Station release in midyear, completing this phase of the investigation of adequate fire control on private forest lands.

Reorientation of range research to fit the U.S.D.A. war program of higher meat production consisted in accelerating analysis and publication of information on proper management and utilization standards for the major forest range types of the Pacific Northwest.

Standards for judging condition and proper use of subalpine grassland range were published in U.S.D.A. Circular 655, July 1942, by Pickford and Reid. In addition to this departmental publication, the range research staff issued the following three Station mimeographs: "Utilization Standards for Mountain Meadows," "Illustrated Key to Important Range Forage Species," and "Appraisal of Range Survey Methods."

The series of continuing war projects commenced in 1942 became more important as the basic problem of shortages of materials and manpower intensified throughout 1943. In addition, special "trouble shooting" jobs multiplied, and during 1943 an estimated 40 percent of the Station's resources were employed directly on war jobs. Indirect contributions amounted to an additional 30 to 45 percent. The quickie jobs included a survey of the number and efficiency of log gang sawmills (labor saving) in the Pacific Northwest, a survey of the production of Douglas-fir and western redcedar for wooden tanks and pipes, and a study of status of production of Port-Orford-cedar battery separators. Accelerated building of submarines accounted for this request. At the request of the OPA, surveys were made at several locations to determine supply and requirements for fuelwood.

A survey was also made at a number of lumber-producing areas to determine the quantity of sawmill waste available for conversion to ethyl alcohol. At least half of the areas surveyed produced enough sawmill waste to supply a 5-million-gallon alcohol plant. The Germans were known to be successfully producing alcohol from wood waste.

Search for substitutes for natural rubber largely centered on two plants which were known to produce latex, the guayule and koksaghyz. More was known of the guayule since it was indigenous to northern Mexico and parts of Texas and had been used for rubber production. An intensive project leading to production of rubber under war

conditions from this plant was undertaken in the Salinas valley, California. Less was known of koksaghyz, a native of Russia, and “a member of the dandelion family” (composite). Two plantations of this plant were established near Klamath Falls. Munger was research adviser to the project.

The Douglas-fir job classification study was the major war job undertaken during the year, and it was completed during 1943. Two reports were issued and submitted to the West Coast Lumber Commission, one covering the logging industry and the other covering the sawmill industry.

To assist Station personnel in conducting this study, eight technical advisers were given temporary appointments, w.a.e. These men represented management and labor elements of the timber industries. A total of 119 separate logging jobs were defined following a canvass of 58 operations, large and small, with a total of some 4,300 workers. Twenty-four of these jobs occurred so infrequently, or were supervisory in nature, that they were eliminated. The sawmill canvass covered 88 mills with some 12,000 workers and 188 jobs were recorded. Of this total, 47 jobs were eliminated from consideration, owing to infrequent occurrence or special nature of duties including supervisory functions. The remaining 141 sawmill jobs and 95 logging jobs were analyzed in detail. The duties of each were described in detail and rated, and prevailing wage rates were recorded by range, median, and average.

Other information considered pertinent to judicial determination of wage scales was included in the report to the West Coast Lumber Commission.

Early in 1943, the office of Western Log and Lumber Administration was established by the War Production Board and headquartered in Portland. F. H. Brundage, Associate Regional Forester of Region 6, was named as the administrator. The primary function of this office was to expedite the production of timber products, chiefly lumber, considered essential to the war effort, although he was vested with emergency authority to enforce his actions. The press dubbed him “the lumber czar.” However, jawbone was often used effectively. Brundage proved to be very effective in this position, owing to his intimate knowledge of this region and the respect for him gained from many years of working with the timber industry. He was provided with a small staff of experts. One was J. E. Lodewick, who was detailed from the Station for the duration of the emergency. To fill the vacancy on the Products staff, Hubert C. Person, senior silviculturist at the California Station, was transferred to this Station. Person, who had worked on logging studies in the redwood region, was put to work on the Douglas-fir job classification project soon after he arrived in Portland the end of February 1943.

Prior to Lodewick’s move to Brundage’s staff, he directed two grade recovery studies as a part of the all-out effort to produce more aero grade lumber. The Alaska spruce log program had been initiated to enlarge the source of spruce logs. A raft of logs from Alaska was cut in a sawmill at Anacortes, Wash. The Division of Forest Products conducted the grade recovery study at this mill. The logs were preselected by use of grades developed by Girard.

The Division also conducted a noble fir grade recovery study at a Portland sawmill. The commercial log grades were used in this study.

Girard, who was used on “roving” assignments of timber production problems nationwide, gave expertise to the aero-spruce program.

As production of timber products accelerated, greater attention was being given by loggers and timber manufacturers to new sources of stumpage supplies. Requests for up-to-date information on the timber inventory became demanding. Although the forest survey had managed to maintain a reduced reinventory program in the Douglas-fir region, it was concentrated in the heavily timbered counties of Oregon, owing to the pressure of war demands for increasing log production. Preoccupation of the forest survey staff on war jobs also limited the size and scope of the reinventory program. The many uses being made of the localized forest survey inventory data and forest type maps by timber operators, public forest-land managers, and wartime agencies demonstrated the importance of not only continuing this program but also increasing the frequency of reinventories and intensifying related forest growth and drain data.

The number of timber companies acquiring and blocking up second-growth forests and cutover lands in anticipation of heavy postwar demand for timber products needed for reconstruction activities was increasing markedly. Forest survey data was a prime source for locating and analyzing acquisition opportunities and planning forest management programs.

To assist in maintaining adequate flow of logs to mills cutting aero grade lumber, the forest survey reinventoried and remapped portions of the National Forests known to have loggable stands of high-quality noble fir.

"Forest Resources of Oregon," a cooperative publication of Oregon State College School of Forestry, Oregon State Board of Forestry, and the Station, was printed by the college and distributed late in 1943. Part 1 of the publication covered the forest resource situation and was written by Moravets, the State Forester and staff contributed a section on protection and management, and Dean Paul M. Dunn of the School of Forestry prepared the section on forest utilization.

Work on forest taxation continued to be financed by Clarke-McNary funds, forest fire cooperation, as it had been when forest economics research funds were not available. DeVries prepared a report, "1943 Tax Rates in Rural Areas of Oregon and Washington Counties," which was published by the University of Washington College of Economics and Business in the July 1943 issue of Northwest Industry. In it, DeVries concluded that there was no evidence in Oregon or Washington that presence of National Forest or other public forest-land ownership in a county correlates in any significant degree with high or low rural tax burdens.

With Lodewick gone and Person engaged on labor studies, Johnson had to spend nearly full time on gathering and compiling statistics on production and consumption of lumber and other timber products. Time was taken, however, to make the biennial inspection of the Region 6 arsenic-paste-treated telephone poles.

The culmination of many years of research in Douglas-fir silviculture and report preparation was the publication of "Reproductive Habits of Douglas-Fir," by Leo A. Isaac. The report was printed by the Charles Lathrop Pack Forestry Foundation, which hastened distribution considerably. This bulletin was used in many ways by forest managers and forest educators as a classic reference. With the accelerating interest in private forest management, it was an exceedingly timely release of basic information.

Anticipation of much greater use of artificial regeneration on nonstocking cutover lands and deforested burns in the postwar period led Munger to plan for new work in planting techniques; specifically, in best methods of handling previously little used species such as Sitka spruce, western hemlock, Port-Orford-cedar, and red alder and in rodent control and methods of reforesting brush areas. The Station completed its work in rewriting and completing Kümmel's manuscript on artificial reforestation.

Only routine work on fire study projects could be done by Morris in 1943 with Matthews absent on detail to the Region. However, a report was prepared for Army Intelligence describing the factors of location, time, and weather most favorable to incendiary attack on the forests of the Pacific Northwest. For the past year, a man (conscientious objector) from the Civilian Public Service Camp at Wind River had been assigned to the Station to work on fire danger data and other jobs. This man had meteorology training and contributed considerably to progress in localizing fire-weather forecasts. He and another man, assigned to Cascade Head Experimental Forest from a nearby CPS Camp, did some routine plot remeasurement and also did necessary maintenance and improvement jobs on the facilities. Morris spent a month at Pringle Falls doing necessary jobs there to keep the plant in shape.

Briegleb made a statistical study of sample scaling of logs and completed an office report. A digest of the report was published in The Timberman early in 1944. Little else could be done on mensurational studies since Briegleb was needed on war studies. In mid-December, Briegleb was transferred to the Tropical Forestry Unit of the Forest Service for a special assignment to Chile to study and report on the forest resources and their utilization. Briegleb was to be a member of a time of five forest experts. The team was headed by I. T. Haig. Other members in

addition to Briegleb were B. H. Payne from Region 6, and L. V. Teesdal and M. H. Maertel from the Madison Laboratory. Findings of the team were published in December 1946 in a 256-page, illustrated report entitled, “Forest Resources of Chile As A Basis For Industrial Expansion.”

During 1943, the Range Research group concentrated efforts on completing analysis of data and preparing reports for publication. The major burden fell upon Pickford as Reid was engaged during half of the year on war projects conducted by the Corps of Engineers, War Department. Pickford published an article on interpreting mountain meadow range conditions in Northwest Science and one in the National Wool Grower entitled, “Range Management Includes Big Game.” Pickford and Reid published “Competition of Elk and Domestic Livestock For Summer Range Forage” in the Journal of Wildlife Management, July 1943 issue. A considerable part of Pickford’s time was spent on extension work, which was the most fruitful type of activity which could be undertaken at this period in the establishment of an adequate range research program. Lack of funds and personnel prevented establishment of fundamental study programs.

Only a modicum of progress could be made in establishing an integrated program at Starkey, development of the physical plant, and designing and installing a comprehensive investigative program. Pickford prepared estimates for the physical plant improvements to be included in the U.S. Department of Agriculture’s postwar planning for the Pacific Northwest, currently being prepared by the several agencies of the department.

Pickford spent 2 months in the summer instructing National Forest personnel of Region 6 east-side forests on fundamentals of judging range conditions and estimating utilization of key forage species. Drawing on experience in both Range Research and National Forest Administration, Pickford was especially effective in such extension activities. He was equally effective in working with stockmen and State fish and game officials. Problems of interrelationships of domestic livestock and big game were multiplying and the Station was allotting more time to planning programs for their solution.

In January 1943, Regional Forester Lyle F. Watts was appointed Chief of the Forest Service by Secretary of Agriculture Claude R. Wickard. Earle H. Clapp was Acting Chief from 1940 to 1942, but continued to hold the office of Associate Chief during this period and until he retired shortly after Watts’ appointment. Assistant Regional Forester Horace J. Andrews replaced Watts as Regional Forester for the Pacific Northwest Region.

By the end of 1943, the allied armies had contained the enemy in most sectors and were initiating offensive action on several fronts, and by the middle of 1944 the Normandy Invasion was launched. War projects continued to form a major part of the Station’s program throughout 1944 as timber products were still a critical item in support of the military forces. However, this was the time to take stock of the changes in the forest situation in the Pacific Northwest and to consider plans for the postwar period when research programs could be directed to solving the critical problems which were developing rapidly from wartime pressures on the forest resource and from dynamics of the total economy.

Chief Watts’ first annual report, covering 1943 and issued early in 1944, reviewed the role of forests as a source of vital products and services in war and in peace. He emphasized the indispensability of wood as demonstrated by war years, but at the same time he pointed to the accentuation of long-standing forest problems by wartime demands. He stated his conviction that total forest values would not be attained until Congress enacted a comprehensive legislative charter and that “the most urgent need is public regulation to stop destructive cutting.” Like Silcox and Clapp, he believed Federal regulation was a necessary basis for remedial action, although in the early years following, completion of the JCC study and report, participation of the States was considered an essential part of recommended legislation. In his first annual report covering 1940, Acting Chief Clapp devoted a few short paragraphs to the use of “cooperative sustained yield units” in solving critical forest management problems where public and private forest land was “inextricably mixed.” On March 29, 1944, the Sustained Yield Forest Management Act was enacted as Public Law 273. The stated purpose of this law was “to promote the stability of forest industries, of employment, of communities, and of taxable forest wealth through continuous supplies of timber.” It

empowered the Secretaries of Agriculture and Interior to establish cooperative sustained yield units consisting of federally owned lands under their respective jurisdiction and to enter into cooperative agreements with private forest-land owners and with State or local government agencies to further the objectives of this legislation.

The forest resource situation in the Pacific Northwest was a major influence in consideration of this legislation and support of the local timber industry and business interests was a major factor in its passage. Results of many of the Station's investigative programs were used in preparation of justification statements for congressional hearings. Subsequently, Station data were used in developing proposals for establishment of "cooperative units."

In the introduction of the Station's in-Service annual report for 1944, Director Wyckoff predicted greater dependence of the timber industry upon second-growth stands for industrial raw material in sections of the Douglas-fir region where privately owned old-growth forest had been heavily depleted. He also pointed out that lack of available old-growth stumpage in the Grays Harbor, Puget Sound, and lower Columbia River districts was resulting in the shutdown of mills and logging operations and accelerating migration of the industry to southwestern Oregon. He foresaw the need for much greater emphasis in developing methods of management of second-growth forests involving practically every phase of forest management research. He recommended that the "Station take leadership in this field, with a program of research on experimental forests together with work on numerous other experimental forests well distributed over the region" (underlining by author). In particular, Wyckoff stressed the need for "revision and refinement of our growth and yield data." He went on to point out the forest growing conditions in southwestern Oregon differing from those of the more northerly part of the Douglas-fir region and called for the establishment of a research center in that area.

Wyckoff cited the importance of keeping the forest inventory up to date as reflected by the changing forest conditions and recommended economic studies of localities and subregions, having in mind the Grays Harbor study. Results of this analysis were published by the Station in "Forests and Forest Industries of the Grays Harbor Unit," April 1944 (Forest Economics Report No. 1). He stressed the need for a strong well-balanced program of forest products research at the Station, citing the strong public interest in improved wood utilization and particularly productive use of waste wood. He called for immediate establishment of a forest products unit at the Station and additional support for the Madison Laboratory to enable greater attention to Pacific Northwest problems.

War studies continued to take up the major part of time of the Divisions of Forest Economics and Forest Products during 1944. In addition to the continuing RPS studies, a number of short special surveys were made, involving agricultural wooden containers, internal combustion units used in logging and milling, fuelwood requirements and production, needs for antifreeze, and availability of wood waste for conversion to alcohol. The Willamette Valley Wood Chemical Co. had been formed and construction of a wood alcohol plant was planned and started at Springfield, Oreg. Dr. J. Alfred Hall[18] of the Washington Office was active in this project in giving technical advice and leadership. The Station also gave assistance and information to the company on sources of wood waste and transportation considerations. Dr. E. G. Locke, a chemical engineer employed by the Bonneville Power Administration, worked closely with the Station staff on chemical wood utilization matters, including the wood alcohol projects. On September 16, 1944, he transferred to the Station, greatly strengthening the Forest Products staff. He spent nearly 2 months at the Madison Laboratory familiarizing himself with their program and collecting recent developments in wood saccharification. He also assisted in correlating the work of the Madison Laboratory with the programs of the Oregon Forest Products Laboratory at Corvallis, which was established in 1941. Dr. Locke completed undergraduate work at Oregon State College.

The Division of Forest Economics regular program was practically at a standstill except for the forest survey. Wilson was engaged full time on war jobs, and funds for the taxation study were closed out June 30, necessitating the termination of Wade DeVries. However, a new project called fire economics was established during the year in the Division under the direction of D. N. Matthews, who had returned to the Station from assignment to the

18 Dr. Hall, Director of the Central States Forest Experiment Station, was transferred to the Washington Office to advise and consult on wood chemistry and other wood utilization problems during the war period.

Regional Office on war studies. The objective of this study was development of principles and methods for determining justifiable expenditures from the societal point of view. Snohomish County, Wash., was selected as a sample area. Previous work by Matthews, Morris, and DeVries in this county provided a fund of supporting data to prepare an analytical report of monetary and nonmonetary costs and damages from forest fire factors.

Impact of war studies continued to limit forest management research to work necessary to keep continuing studies up to date through plot remeasurements and preparation of progress reports. Work in Douglas-fir silviculture was confined primarily to the partial cutting studies. Isaac found time during 1943 and 1944 to make a study of decay entrance following logging injury in cooperation with the Office of Forest Pathology, and a report was prepared by George H. Englerth of that office and Isaac which was published in The Timberman, July 1944, under the title, "Decay of Western Hemlock Following Logging Injury."

Prior to Briegleb's leaving on the Chilean assignment, he prepared a memorandum report, "Progress in Estimating Growth of Selectively Cut Ponderosa Pine." Since the publication in 1934 of Meyer's bulletin on this subject, much additional information had been gathered on growth and yield. Some had been compiled and published by Briegleb. Additional publications were planned from his memorandum report. Briegleb returned on August 10, 1944, from the Tropical Forestry Unit, but on November 1 of that year was transferred to the Northeastern Forest Experiment Station to head the forest survey of that region. For the first time since the Station was established in 1924, it was without the services of a trained mensurationist. Professor George H. Barnes of the Oregon State School of Forestry was seasonally employed for 6 weeks to work with other Station staff in remeasuring permanent sample plots to prevent interruption of continuity values in these important series of plots.

"Forest Planting in the Douglas-Fir Region," by J. F. Kümmel, C. A. Rindt, and T. T. Munger, was issued as a Station multilith in June 1944. The reception given this report justified the considerable amount of work the Station expended on it during the previous 2 or 3 years.

Progress on range research projects was again hampered by lack of personnel and a good part of the available time was spent on manuscripts, extension work, and postwar plans. Reid was absent on war jobs about 9 months of the year. Robert S. Rummel, range examiner, was added to the staff July 1, but did not receive permanent appointment until October. G. D. Pickford transferred to an administrative position in Region 2, the Rocky Mountain Region, November 1. Personnel changes were occurring rapidly during this period. E. G. Dunford returned to the Station from the Rocky Mountain Forest Experiment Station October 1.

In the Washington Office, E. I. Kotok, Assistant Chief in State and Private Forestry, replaced C. L. Foresling, who left the Forest Service, as Assistant Chief in Charge of Research. Effective January 1, 1945, Wyckoff was transferred to the directorship of the California Station. M. W. Talbot had been Acting Director at that Station since 1941 when Kotok was moved to Washington. Dr. J. Alfred Hall was named Director at this Station in place of Wyckoff but did not report to Portland until July 1, 1945, pending completion of war jobs. Wyckoff divided time between Portland and Berkeley, moving permanently April 1. In the meantime, Cowlin acted as Director.

The transition from war conditions to peace brought many changes in the direction and character of the Station's program. With a new director and other changes in personnel, it was clearly the time to review past programs and make long-range plans for meeting new problems bound to develop in a postwar economy. At the same time, many of the old problems were resisting solution. Dramatic developments in industrial technology had taken place during World War II. Many of these were based upon crash programs of scientific research. The response of the Nation's industry and business economy to war demands in becoming the "arsenal of democracy" restored public confidence in the industrial economy lost during the Depression. The scientist gained in respect and recognition, losing the "ivory tower" image. New tools and techniques were becoming available to the research workers. Before these could be employed, however, the war-induced programs had to go through a winding down process. War-related projects, financed by the War Production Board, continued throughout 1945. Other Station projects, chiefly the forest survey and forest products efforts, were still substantially war oriented. Obviously, considerable time was

required to reanalyze and appraise the forest problems of a forest region such as the Pacific Northwest where the war impact was heavy. The timber industries were likewise reassessing their policies and programs. The day of relatively cheap, available, old-growth stumpage and high-grade logs was evidently passing for many timber operators. The open log markets of Puget Sound, Columbia River, and Grays Harbor were virtually gone, at least as a truly competitive market. Mills dependent upon log purchases for raw material supply were finding it difficult to compete with those having assured sources. National Forests and other public forest lands were becoming the only source of timber supplies for some manufacturers. As a result of these factors, some plants were shutting down. The owners were either moving to other parts of the region where stumpage was available or liquidating their investments. Conversely, some of the better heeled concerns were acquiring second-growth forest lands or small tracts of privately owned old growth and making new investments in plant capacity. Generally, it was the large companies with substantial holdings of advance second growth and old growth who were engaged in acquisition programs. Some concerns viewed the cooperative sustained yield law as an opportunity to secure a stable raw material supply. On the other hand, there were some people who were critical of the proposals for establishment of public-private sustained yield units. Public interest in improved forest management and utilization was at a high point. Both Oregon and Washington had enacted timber conservation acts. Neither of these laws, however, had any significant provision for control of cutting practices and were aimed primarily at obtaining adequate regeneration.

The tree farm program was gaining momentum and the region appeared to be on the threshold of intensive forest management. There were trends toward closer utilization in woods and mills. In the woods, trees were being utilized to a smaller top diameter and high stumps were a thing of the past. Interest in utilization of sawmill waste was increasing. The Springfield alcohol plant was an example. However, these developments were primarily profit motivated, although the timber industry was becoming conscious of public opinion and attention was being given to improving public relations. The industry was sensitive to the naming of unused material as “waste” and was using such terms as woods “leftovers” or mill “residues.”

Forest fire protection was improving and the two States were strengthening the State forestry offices by funding and staffing with well-trained professional foresters.

By the end of 1945, Director Hall had a clear grasp of the major pressing problems and had initiated action to reshape major elements of the Station’s program. He planned for increasing research in methods of intensive management of second growth and demonstrating these methods at field research centers. Hall reoriented the Forest Products Division and renamed it the Forest Utilization Service. Closer relationships with the Madison Laboratory were established by this move. The FUS would bring to the timber industry results of the work at Madison and encourage their application, and from their knowledge of the regional industry problems help in shaping Madison Laboratory programs to meet current situations. Locke was made a member of the FUS unit and Elmer E. Matson, a University of Washington College of Forestry graduate, was transferred from the Washington Office as a second member of the unit. Matson had considerable practical experience in the timber industry of the Pacific Northwest and elsewhere before joining the Forest Service. Johnson continued to handle the lumber census and other timber industry statistics, including minor forest products.

There were other notable additions to the Station’s staff during 1945. In May of that year at the request of Bonneville Power Administration, the Station undertook a comprehensive study of the forest industries, their raw material base and trends of future development, and the relationships between such developments and electrical power markets in the Columbia Basin. The study was to continue through fiscal years 1946 and 1947 and was financed by BPA. Dr. Ralph W. Marquis, a trained economist on the staff of the Division of Forest Economics of the Washington Office, was transferred to the Station to direct this project. The Northern Rocky Mountain Station cooperated in furnishing forest resource and industry data for portions of the Columbia Basin in their territory.

Joseph E. Pechanec, forest ecologist, was transferred July 1 from the Intermountain Forest and Range Experiment Station to head the Division of Range Research. With Pechanec's arrival, the Division initiated a program of forest range reseeding. Work of the previous 9 years in studies of grazing management of forest ranges and application of their findings to National Forests had progressed to the point of incorporation into administrative practices. Some study had been done on two critical problems; the impact of big-game grazing and the loss of range resources by invasion of trees in grassland and meadows. Much work remained on these problems to restore the lands to optimum range use.

Forest management research by the reduced staff was centered principally on maintaining going long-time studies. Isaac continued to cooperate with Forest Pathology personnel in determining extent of decay in western hemlock and Sitka spruce from logging injury. He also made studies of effect of sunscald on reserve trees left after partial cutting. Munger revised and edited Briegleb's extensive manuscript, "Calculating the Growth of Ponderosa Pine Forests," which was scheduled for publication in December 1945. Munger, assisted by Fedde of a CPS camp personnel, prepared many progress reports on the permanent sample plot series in the Wind River area.

The Tillamook Burn was the object of study by several of the Station's divisions. After the original devastating fire of 1933, there were two reburns, one in 1939 and another in 1945. Public attention was attracted to the problem of rehabilitating this area. The recent reburn had eliminated most of the regeneration that had occurred after the original fire and eliminated as a seed source the small green areas that had survived earlier fires. There was much agitation for immediate planting programs. However, the many standing snags constituted a high hazard. Salvage operations to date were largely confined to removing high-grade logs with accompanying hazard reduction by snag falling. The Forest Utilization Service, working with Forest Management staff, were considering the opportunities for experimental operations in cooperation with State, county, and private representatives to study costs and returns for complete salvage, hazard reduction, and planting programs. The thinking was that results of such studies would also have application on other large deforested burns in the Pacific Northwest.

The forest survey reinventory program was further curtailed during 1945. In addition to many service jobs from individuals and agencies seeking new timber supplies and related information, the reappraisal project obligated a large share of the staff's time. The 1945 reappraisal, conducted by the Forest Service, was one of the periodic reports on the state of the Nation's forest resource. The basic resource data were collected for the year 1945. Several years were to elapse before the data were analyzed and coordinated in the Washington Office and a report issued. The American Forestry Association was conducting a similar analysis of the forest resource situation at the same time, using essentially the same basic data.

The fire economics project had reached the reporting stage for the initial study. Matthews prepared a manuscript for review titled, "Economic Study of Forest Fire Control in Snohomish Area, Washington." The manuscript was revised after intensive review by other Station members and the Regional Office and a finished draft sent to the Washington Office for review and approval. During July, Assistant Chief McArdle, for State and Private Forestry, visited the region and while here discussed the report with the Station. McArdle found the report acceptable but suggested changes for future work, pointing out that since Clarke-McNary funds were financing this project, it should be directed to results for immediate application to Clarke-McNary programs. Specifically, it should assist the current job of revising cost of adequate protection estimates, and analysis of National Forest fire control units should not be involved in the analysis. Moreover, emphasis should be changed from publication of reports for general consumption to production of results for early use of Clarke-McNary administrators.

On June 1, E. G. Dunford, who had assisted Matthews on the fire economics study, transferred to the Southeastern Forest Experiment Station (then called Appalachian Forest Experiment Station) in Watershed Management Research. Director Hall, in his annual report for 1945, pointed to the need for watershed management research in the Pacific Northwest which could not be undertaken at this time for lack of appropriations.

The newly created Forest Utilization Service unit was immediately engaged in a variety of projects. Locke gave technical assistance to the development of the two local alcohol plants; the waste sulphite liquor plant at Bellingham and the wood hydrolosis plant at Springfield. He also continued advising the Oregon Forest Products Laboratory at Corvallis and worked with them on a study of production of commercial charcoal from sawmill waste. Locke also helped set up two cooperative projects with the Bonneville Power Administration; one was an energy survey of the Pacific Northwest and the other was a study of the possibility of using dissolving pulp in manufacturing synthetic fibers and plastics. Starting June 11, Locke was on a 5-month detail to the Foreign Economic Administration in Germany, investigating their chemical utilization of wood for possible use in our industries. Matson assisted R. F. Luxford of the Madison Laboratory in a study of the utilization of low-grade and short-length material in glued-laminated structural members. The studies were conducted at two local plants of the Timber Structures Co.

The Requirements, Products, and Supplies war project continued through the year. Wilson, Person, and Lodewick, who had returned to the Station from an assignment with the Western Log and Lumber Administration, comprised the staff. The end was in sight, however, for this project; on September 2, Person transferred to the Southern Forest Experiment Station, and on November 14, Lodewick transferred to the Bonneville Power Administration.

Others were on the move, too. Cowlin spent most of November and December in the Washington Office at a conference to review and reorient objectives and policies of the nationwide forest survey. Isaac was granted a 6-month leave effective December 1 to work with the University of Washington College of Forestry on a study of the relationship of Douglas-fir seed source to nursery practice and planting.

Christina McPhail returned from military furlough on August 30, 1945, after a year's service in the WAC. She resumed her duties as secretary to the Products group.

Mobility of personnel has been a characteristic of Forest Service policy, even to the point of arousing some public criticism, particularly of horizontal moves. This is probably more true of the Administrative Branch than of Research. In fact, the Pacific Northwest Station in early years seemed to be singularly unaffected by this characteristic except for budgetary inflicted personnel changes. The war years, of course, were an exceptional period in this respect. Restoration of a peace-time economy brought many changes to the Station; increased funding, reorganization of research programs both in form and substance, and changes in policy. Many personnel moves were a natural consequence. Additions to the staff came through intra-Service transfers and from other agencies and by appointment from Civil Service rolls. Release of men from the military filled the roster with many well-qualified and mature professional foresters.

Autumn 1946 was marked by three retirements which tempts this author to use a cliché, "the close of an era." On October 31, Thornton T. Munger, Director from 1924 to 1938, and June H. Wertz, administrative assistant, retired, both after about four decades in the Service, practically all in the Pacific Northwest. Herman M. Johnson, associate forester, Division of Forest Products, retired September 30 after 36 years in the Forest Service, all spent in this region. Herman immediately joined the staff of The Timberman. Publisher George Cornwall recognized the value of his encyclopedic knowledge of the region's timber industry.

June Wertz and Thornton Munger were a team which had the responsibility for establishing an institution of forest research in the Pacific Northwest. They believed in adherence to Forest Service rules and regulations and complete fiscal accountability. They gave a full measure of personal time and effort to their responsibility as public servants in expenditure of Government funds. Upon their retirement, Regional Forester Andrews commented, "If it hadn't been for June Wertz and Thornton Munger, I would have been in McNeil's Island (location of the Federal penitentiary) for what I didn't know about Government work in general and forest survey work in particular." Of course, there was a bit of hyperbole in that statement, for "Hoss" Andrews was the soul of honesty; however, he had little use for bureaucratic red tape when it hindered discharging the overriding public trust in accomplishing his assigned duties.

Samuel E. Kistler transferred from the Madison Laboratory to succeed June Wertz as administrative assistant effective August 11, 1946.

Philip A. Briegleb returned to the Station from the Northeastern Station May 5, 1946, and upon Munger's retirement became chief of Forest Management Research. A major reorganization plan had been developed, and a substantial increase in funds allotted for this work from fiscal year 1946 appropriations enabled the Director to put it in motion during calendar year 1946. The essence of the plan was to divide the Station's territory into several homogeneous areal units called research centers, based upon geographic distinctions and character of the forest resource. The objective of this reorganization was to make results of research more effective through more intensive problem analysis, more timely establishment of study programs, closer relationship between the research worker and the physical problem area, and to close the gap between research and application in practice. Each of the centers was to have a local headquarters with a resident technical and clerical staff. Eight centers were tentatively established on paper, two of which were to be primarily concerned with range management problems. These were Eastern Oregon and Eastern Washington Centers. The remaining six forest management centers were the Northwest Washington Center, the Western Washington Center, the Wind River Center, the Western Oregon Center, the Southwest Oregon Center, and the Central Oregon Center. Changes were made later in the number and names of the centers. Obviously, the overall plan and implementation of it would have to go through a shakedown period before it would be in effective operation.

Two of the forest management centers were established and staffed in the latter half of the year when fiscal year 1947 money was in hand. The first of these was the Western Washington Center headquartered in Olympia, Wash., with temporary office space in rented quarters in the St. Paul & Tacoma Lumber Co. office building. Norman P. Worthington of the Crossett Lumber Co., Crossett, Ark., was appointed October 21, 1946, to take charge. A University of Washington graduate in forestry with a master's degree from the Yale University Forest School, Worthington had previous experience with the Forest Service and had been at Crossett, Ark., since 1937, where he had unique experience in progressive industrial forest management. George R. Staebler, a professional forester with the Tennessee Valley Authority, was obtained by transfer also in October. The Western Oregon Work center was quartered in Corvallis with the Siuslaw National Forest. Robert Aufderheide was transferred to the Station November 18, 1946, from the Forest as the Research Center leader. Harold A. Rapraeger, who had transferred to the Station from the Snoqualmie National Forest previously to work on fire studies, was attached to the center, and on July 1, 1946, Roy R. Silen, recently released from the Army and appointed from the Civil Service rolls, completed the technical staff of this center.

Edwin L. Mowat was transferred to the Station from the Columbia National Forest (now, Gifford Pinchot) October 6, 1946, and assigned to the Central Oregon Research Center. Walter G. Dahms was given an appointment on November 25, 1946, and also assigned to this center. Headquarters were not established for this center until February 1947. It was located in rented quarters in Bend. In the meantime, Mowat and Dahms were assigned to Pringle Falls Experimental Forest, preparing for revival of ponderosa pine forest management studies in the spring and doing necessary plot and plant maintenance work. Wind River Experimental Forest was also staffed by the appointment of Robert W. Steele, who had previously worked at Wind River for a short time prior to joining the Navy in 1944. Robert H. Ruth and Melvin P. Twerdal were also given appointments late in the year and assigned to the Cascade Head Experimental Forest.

Two new projects were initiated in 1946. These were forest soils studies and applied forest management. The first of these was entirely new to the Station and to the Pacific Northwest for that matter. Applied forest management was new conceptually to this Station, although results of forest research had been applied in some cases on Experimental Forests of the region for a number of years.

Robert F. Tarrant, soil scientist (forestry), was transferred to the Station from the Soil Conservation Service, September 22, 1946. This gave the Station the technical ability to study basic soil problems as a factor in forest management. Later, influenced by the Station's work in this field of study, Crown Zellerbach Corp. and

Weyerhaeuser Timber Co. added soil scientists to their forestry staffs, and the forest schools of University of Washington and Oregon State College were staffed to offer instruction in forest soil science. This led to the formation of a Forest Soils Committee for the Douglas-fir region, which has been active in enlarging the understanding of the importance of forest soil studies and their application in improving forest management practices. An interesting sidelight is the temporary employment of two met as field assistants who later became well known for their work in forest soils. One was Theodore Coile, who worked at the Station for several seasons a few years after it was established, and Willard H. Carmean, who first worked on the forest survey as an agricultural aid in the summer of 1946.

The concept of applied forest management consisted in testing conclusions reached from small sample-plot silvicultural, mensurational, and fire studies and from related economic analyses on woods operations of commercial size. The work was to be done on the Wind River, Cascade Head, and Pringle Falls Experimental Forests. To fully implement the plan, either new appropriately located experimental forests would have to be established or cooperation arrangements be made for other study tracts dedicated to this objective. Matson was particularly well qualified to direct this program from his past experience and knowledge of regional forest conditions, and he was placed in charge of the applied forest management unit. The immediate plan was to study second-growth Douglas-fir management in western Washington, old-growth Douglas-fir management, and spruce-hemlock management in western Oregon and ponderosa pine management in central Oregon.

The many personnel and program changes reduced the outflow of completed research results this year. Before retirement, Munger made the eighth remeasurement of the first growth plots established by him in 1910. This provided a history covering 36 growing seasons of growth and mortality of a Douglas-fir stand typical of much of the site II lands on the west side of the Cascades.

Preparation of a progress report by Isaac of 10 partially cut areas in Douglas-fir showed a significant loss of sound wood volume by decay since cutting 5 years previously. Loss was at the rate of 1 percent per year.

Tests of smoke-searching techniques by Morris indicated that aerial detection efficiency could be increased materially by employing known principles of visibility.

Donald N. Matthews, after 16 years at the Station on the forest survey and fire studies, transferred to the staff of the Regional Forester of Region 1, the Northern Rocky Mountain Region, in Missoula, Mon.

Under Pechanec's leadership, plans for study of cattle management on the Starkey Experimental Range were prepared. Briefly, the program was to compare season-long and rotation-deferred systems of management, each at three different grazing intensities.

Seedlings were made in 1946 on all test areas established in 1945. Three of the range reseeding tests were in the sagebrush type, two on the cheatgrass type, and 10 were in the ponderosa pine grassland type. Four trials and a grass nursery were located in eastern Washington and the remaining trials were in eastern Oregon. Cheatgrass, low in grazing value and high in fire hazard, was a conspicuous problem on central Washington ranges. A 2-year study testing 12 methods of planting perennial grasses in cheatgrass was established on a large ranch near Wenatchee to determine effective seeding methods and extent of fire hazard reduction.

A reseeding equipment development program was underway in cooperation with the Forest Service Equipment Laboratory at Arcadia, Calif., guided by an interregional committee chaired by Pechanec.

Additional funding of range management research for fiscal year 1947 enabled a reorganization of the Station's program and strengthening of the staff. In mid-1946, all of the staff except the division chief were moved to field stations. R. S. Rummel was put in charge of work in central Washington with headquarters at Wenatchee, and E. H. Reid was placed in charge of work in eastern Oregon and headquartered at La Grande. Three men were added to the La Grande staff soon after Reid completed establishing the unit headquarters and personnel selections were

made. E. W. Stevenson came from the Emergency Rubber Program October 28, 1946; Robert W. Harris was transferred from the Rocky Mountain Station January 26, 1947; and George A. Garrison was transferred from the Soil Conservation Service January 13, 1947. This group added experience and training in plant ecology and soils to the staff.

At the forest survey conference in November 1945 in the Washington Office, national objectives and policies of the survey were reviewed and reformulated to meet new and developing conditions. Following the conference, Cowlin remained in Washington to work with Crafts in preparing the first draft of a national forest survey manual for guidance of the field offices. Progress during the war in aerial photo interpretation and development of new sampling techniques led to radical reorientation of regional forest survey methods and programs for 1946 to meet new specifications, including determination of the statistical sampling accuracy of major elements of inventory, growth, and drain data. Progress of instituting new methods and the field program at this Station was hampered somewhat by the detail of Cowlin to the Reappraisal Project from January to June. Selected field personnel were called to Washington to work with Assistant Chief Marsh in preparing the Forest Service report on the Reappraisal. The survey staff was further diminished by transfer of George S. Meagher in April to the Southwestern Forest Experiment Station to take over the forest management program there upon G. A. Pearson's retirement. Fortunately, with increased allotment of funds, two additional men were added to the survey staff in midyear, each possessing particular skills needed for the reoriented program. Floyd A. Johnson transferred from the Federal Corp Insurance Corp., July 8, 1946. Johnson had two degrees in forestry from Iowa State College—a B.S. in 1939 and a M.F. in 1941—and had special training in statistical methods. Richard C. Wilson was transferred to the Station in July from the California Forest and Range Experiment Station. Wilson had prewar experience on the forest survey in California and was an officer in the Air Force from October 1942 to December 1945, doing aerial photo interpretation duties in the Asiatic theater.

In May 1946, a 2-week conference was held at Harvard Forest, Petersham, Mass., to discuss and develop techniques for the forest inventory. Cowlin went with Crafts from Washington, D.C., and Moravets and Wilson attended from the field.

Following the meeting, a regional working plan was prepared by Moravets with assistance from other staff members, particularly on photo interpretation by Wilson and sampling techniques by Johnson. It was designed to meet the new objectives and policy. Aerial photos, when available, were to be used for preparation of type maps and determination of forest type and condition areas. Timber volume was determined by random sampling. This plan also included methods of obtaining gross growth and mortality with the inventory.

In December, a forest survey conference was held in Portland to consider methods of determining cutting drain, a particularly important problem in the Western States. It was attended by Crafts and Osborne of the Washington Office and representatives of the Northern Rocky Mountain, California, and Pacific Northwest Forest Experiment Stations. The conferees decided to request Budget Bureau approval of a questionnaire for canvassing by mail and personal visit the primary producers of logs and other round timber products.

The fire economics project was closed out with the completion of the final report and transfer of Matthews. After review it was decided not to publish the report since analytical methods used did not result in any valid conclusions. With modern methods of economic analysis and data processing equipment and processes, the study probably would have been successful. For example, the input-output analytical procedure developed at Harvard by Professor Wassily Leontief of Economics was commencing to be used at this time in economic studies but was not known to forest economists when this study was conducted.

The RPS was settling down to a few routine jobs, although Sinclair Wilson prepared a special report on the softwood-plywood situation.

As a part of the reorganization of the Station's programs, the Division of Forest Economics was given responsibility for grade recovery studies which were assigned to the section of financial aspects. It was decided to initiate a series of studies in four or five mills to determine recoveries from certain forest types not covered by previous studies. Fieldwork was finished during the year with the cooperation of the West Coast Lumbermen's Association, Region 6, and the O&C Revested Lands Administration (the BLM).

James J. Byrne was transferred January 13, 1946, from the Emergency Rubber Project to head the Station's Forest Utilization Service. The staff was further enlarged by the transfer of Archibald C. Knauss from the Forest Products Laboratory, August 11, 1946. However, in October Knauss was moved to the Division of Forest Management Research to join Matson on the applied forest management staff.

There were a number of significant developments in forest utilization in 1946. These were: (1) completion of construction of the Springfield alcohol plant; (2) successful startup of the Bellingham sulfite alcohol plant; (3) large increase in salvage logging of cutover lands in the Douglas-fir region; (4) successful pilot plan operation of a board plant using Douglas-fir mill waste; and (5) construction of a commercial-size fiberboard plant and construction of additional sulfate and soda pulping capacity to utilize Douglas-fir mill wood waste.

Responding to the expanding interest in utilization of low-grade material, Matson and Professor John B. Grantham of Oregon State College completed a study of salvage logging, and results were published under their authorship as Oregon Forest Products Laboratory Bulletin No. 1, Oregon State College, "Salvage Logging in the Douglas-Fir Region of Oregon and Washington," May 1947.

Early in 1947, the Forest Utilization Service, under Byrne's leadership, made a cooperative in-Service study of the cost of hauling logs by truck and trailer and the effect of road design on hauling costs. Forest engineers from Forest Service Regions 1, 5, and 6 assisted Byrne. Nineteen timber operators in Montana, the three Pacific Coast States, and British Columbia, and the Oregon State Highway Commission contributed data and technical information to this study. Logging engineers and road designers had needed such information for years, and publication of the completed report was expedited. The detailed report was published by the Station in October 1947 as a 112-page multilith titled, "Cost of Hauling Logs By Motor Truck and Trailer," by J. J. Byrne, R. J. Nelson, and P. H. Goggins. This publication soon became a bible for road engineers, and several years later it was brought up to date and reissued. A condensed version of the original was published by the Pacific Logging Congress in the 1947 Loggers Handbook under the same title and authorship.

The Springfield alcohol plant, after experimental operation for the first half of 1947, closed down for mechanical shortcomings and on account of lower market prices for industrial alcohol in the postwar economy. Considerable information was developed by the Forest Utilization group on the production of alcohol, molasses, and yeast from wood waste and from cooperative feeding tests for wood molasses and yeast arranged with the Agricultural Experiment Stations.

In keeping with trends in the Douglas-fir lumber industry towards greater market demand for seasoned lumber, the FUS staff promoted a 2-week course in kiln drying at Longview, Wash., for operators. Instruction was given by members of the Madison Laboratory staff. This was the first such training course given by the Forest Service in 25 years in the Pacific Northwest. Other fields of activity of the FUS were directed towards greater use of low-grade material and included the following: The expanded use of low-grade logs by the softwood-plywood industry; the development of a cut-stock industry based upon salvaging sawmill waste; fabrication of wood products of glued-laminated construction; development of insulating and hardboard plants to utilize waste wood; and expanding use of sawmill and logging waste and thinnings for manufacture of paper pulp.

On November 1, Jim Byrne, Chief of the Forest Utilization Service, transferred to Region 5 of the Forest Service as regional engineer. In the scanty 2 years Byrne was at the Station, he made notable contributions to progress in improving forest utilization information and services in this region. He was replaced by Dr. E. J. Locke as head of the Unit.

The first, and what was destined to be the only, cooperative sustained unit with a private forest-land owner became effective January 1, 1947, when a contract was made between the Forest Service and the Simpson Logging Co. under Public Law 273. The contract was written to operate 100 years. This time period was deemed to be a suitable rotation from seedling to harvest cut. It was commonly called the Shelton Unit, and it contained 159,000 acres and 1 billion board feet of timber committed by the company and 111,000 acres and 4.4 billion board feet of timber committed by the Forest Service.

Although no other private cooperative units were established, two Federal units were established in the Pacific Northwest later, one at the Grays Harbor area in western Washington and one in southeastern Oregon in the area around Lakeview. Three other Federal units were established, two in the Southwest and one in California.

The year 1947 was a climactic one in several respects. On June 30, the emergency Requirements, Production, and Supplies program, conducted during the war years and for a short time in the critical beginning of the postwar period, was terminated. The ready response to this emergency and the manner in which time-pressure jobs were conducted raised the stature of the Station in the respect of the timber industry and informed public in the Pacific Northwest. It also gave the Station staff confidence in the capacity of Research to undertake and complete new and difficult assignments and satisfaction in the value of their contributions to the Nation's defense.

The Bonneville cooperative project was completed on schedule, June 30, 1947. By agreement with the Bonneville Power Administration, the project was extended an additional 6 months to include an intensified study of selected Oregon counties. This study forecasted production and employment in the timber industry by products for each year from 1948 to 1960 for each of nine southern Oregon counties. The supplemental study was completed before the year's end and the reports submitted to BPA. The findings of these studies, with data on power requirements added by the BPA, were incorporated in a report the U.S. Corps of Engineers submitted to Congress. Dr. Marquis transferred to the Division of Forest Economics Research of the Washington Office, effective September 21, 1947, to head the section on forest finance.

A major effort of the forest survey was the development of working plans to meet the new national objectives and specifications. This included preparation of a detailed field manual. Distribution was not confined to in-Service use, as other agencies had requested copies. The section on interpretation and use of serial photos was of particular interest to them.

The year commenced with a 3-day training session at Wind River the end of January. Several new men had been added to the field-going staff. Training in estimation of cull, an important aspect in timber volume inventory procedures in the old-growth Douglas-fir types, was given by Dr. Childs of the Forest Pathology staff. Two days were spent in training in the use of form-class volume tables, which had been developed by Jim Girard who had joined the firm of Mason, Bruce, and Girard in Portland. The key to applying these tables was the ability to estimate ocularly the diameter inside bark at the top of the first 16- and 32-foot logs, no mean trick in the rain and gloom of the dense old-growth forests.

A national forest survey techniques conference was held at Eagle River, Wis., September 29 through October 10, 1947. Cowlin and Moravets presented papers dealing with aspects of the growth, drain, and analytical phases of the survey. Johnson made and presented a special analysis of sampling problems. Marquis also attended en route to report to the Washington Office. The PNW attendants also figured prominently in extracurricular activities. Johnson and Moravets won the horseshoe pitching tournament (a tribute to their academic days at Iowa State College) and Marquis and Cowlin were the cribbage champions. Moravets also gained notoriety by organizing

daily pools on the baseball World Series and winning two of the first three, with Cowlin winning the other. Fortunately, George Gevorkiantz of the Lake States Station won the next day and the integrity of the pool management was established when Dr. Crafts, leader of the conference, finally won the last day.

The Division of Forest Economics apparently had established a reputation for "Have savvy, will travel—for cash, that is." At the request of the Lake County, Oregon, Chamber of Commerce, the Division made an industrial survey in the Lakeview area of the volume and utilization of mill and woods waste in cooperation with local timber companies. The chamber made cash contributions to help cover salary and expenses of Sinclair Wilson who conducted the study. A second cooperative agreement was made with the Harbor Plywood Corp. for a more intensive survey of their holdings in Douglas County, Ore., during the course of the forest survey reinventory of that county. The county contributed $1,000 to cover the extra work done on their land.

The enlarged staff of the Division of Forest Management Research were busy getting established at the new branch research centers and reactivating Cascade Head, Pringle Falls, and Wind River Experimental Forests. William E. Bullard, Jr., was transferred from the Washington Office effective May 1, 1947, and was placed in charge of the Wind River Center. Bullard had previous experience in watershed management research.

In support of the second-growth management program, additional experimental areas were needed that would typify private forest-land conditions. A plan was worked out for the Station to enter into 20-year lease agreements with private owners to establish "cooperative experimental forests." The first of these, the Voight Creek forest, was negotiated December 1, 1947, with the St. Paul & Tacoma Lumber Co. in a 35-year-old stand. A second cooperative experimental forest was selected near McCleary in the Puget Sound area, and a year later a 20-year cooperative lease arrangement was made with the tract owner, the Simpson Logging Co. These two areas were typical of second-growth stands of the Puget Sound area, easily accessible with nearby markets for material removed in experimental cuttings.

In view of the urgent demand for information on second-growth Douglas-fir management from private and public forest-land owners and managers, the Station planned a greatly expanded program. A three-point plan was prepared for presentation and consideration of interested agencies and potential cooperators: (1) the Station, with the help of other agencies, would quickly assemble all that foresters know then about this subject; (2) the Station would set up permanent experimental tracts in cooperation with forest-land owners to test promising methods of stand improvement, utilization, and harvesting methods; and (3) the Station, with the help of forest-land owners, would study and report on results of all classes of current cuttings in second-growth stands. The plan was presented and discussed in a townhall meeting in March and unanimously endorsed. The Station quickly organized a nine-member steering committee representing the various interests. The committee, named the "Douglas-Fir Second-Growth Management Committee," consisted of W. D. Hagenstein, Industrial Forestry Association; Dean W. F. McCulloch, Oregon State College; D. G. McKeever, Weyerhaeuser Timber Co.; T. P. Plair, Soil Conservation Service; G. A. Rindt, Region 6, Forest Service; E. P. Stamm, Crown Zellerbach Corp.; L. T. Webster, Assistant State Forester, Washington State Department of Natural Resources; and L. A. Isaac, secretary, and P. A. Briegleb, chairman, representing the Station.

Late in 1946, the Station cooperated with Region 6 and the Bureau of Plant Industry, Soils and Agricultural Engineering, in a soil survey and study of soil-forest type relationships in the pumice soils of central Oregon. In a followup study, Tarrant confirmed the relationship between soil drainage and occurrence of lodgepole pine and ponderosa pine. Results of the study showed that planting of ponderosa pine should be confined to the well-drained sites. Conversely, lodgepole pine was found to grow vigorously on wetter sites excluding ponderosa pine.

In 1939, cuttings from the 25 most promising hybrid poplars developed in the Northeast were planted in this region in a cooperative plantation with the Crown Zellerbach Corp. Results of this test and growth comparisons with the native cottonwood were summarized by Silen in his "Comparative Growth of Hybrid Poplars and Native Northern Black Cottonwoods," Forest Research Note No. 35, October 1, 1947.

The Station started a study in 1946 to learn more about the ecological effects of burning upon establishment of tree seedlings, brush, and other vegetation as compared with nonburning of slash on cutover lands in the Douglas-fir region. In the 1946 burning season, Morris established seven paired plots. One of the pair would be slash burned and the other not burned. He made the first annual examination of these in 1947 and laid out 28 additional pairs for burning in the following season. It was planned to expand the study for several more years.

Applied forest management personnel installed two systematic timber-cutting studies at Cascade Head Experimental Forest and on the Henderson Creek area in the Siuslaw National Forest. The first was a commercial timber sale of 8 million board feet in a 100-year-old stand of spruce-hemlock and the second was an 11-million-board-foot sale in a 150-year-old Douglas-fir stand.

Among other visitors at the Station during 1947 was Secretary of Agriculture Clinton Anderson who spent 2 days in July at Pringle Falls in company with two of his friends, executives of the Pope & Talbot Lumber Co. Also in the party were Director Hall, Regional Forester Andrews, Briegleb, and Supervisor Ralph Crawford of the Deschutes National Forest.[19] The Director, reporting on the trip in a staff meeting, commented that the visiting dignitaries cleaned up in an evening penny ante poker game; perhaps it could be better named "diplomatic checkers," and not a real test of card playing skills.

Major emphasis of the Division of Range Research, including an extended full staff conference, was on acquainting new staff members with flora and range problems of the region and developing the Starkey Experimental Range in preparation for the intensive study program planned. Construction of roads and fences began. A headquarters site plan was made and laid out. The area was cleaned of debris and graded and a temporary office building moved from a nearby ranger station.

Rummel attended the statistical training course in the Washington Office starting in mid-October; he returned to field duty the following February.

Pechanec received a cash award from the Society of American Foresters for the best article appearing in the Journal of Forestry during 1947. The article, "Cheatgrass—A Challenge To Range Research," was published in the August issue and coauthored by A. C. Hull of the Intermountain Station. Considering the subject of the article and the 100 competing articles, it was a tribute to Pechanec's scientific qualifications and his concise and readable factual reporting.

A disastrous flood occurring in the Columbia River Basin in the spring of 1948 dramatically called attention to the need for watershed management research to gain a better understanding of the role of forests in controlling runoff in this forest region.

The most visible damage from this catastrophe occurred the last few days of May in the lower Columbia River in a Portland suburb, Vanport, which was a mushroom city established primarily to house shipyard workers during the war and later converted to general housing. It was nearly completely submerged with great loss of property and contributed to the loss of a few lives.

Not so visible to the public was the property loss in the forested parts of the watershed from destruction of physical improvements such as roads, bridges, and buildings and severe loss of forest soil. A Forest Service team was established, headed by Dr. Reed Bailey, Director of the Intermountain Forest and Range Experiment Station,

19 Crawford started his career with the Station as a junior forester on the forest survey in the early 30's.

with members from Forest Service Regions 1, 2, 4, 5, and 6, including both administrative and research personnel, to evaluate damage to the forest and range lands and to study contributory conditions. Since need for the information was pressing in order to present the situation in proper perspective to Congress and the public, a "quickie" report was planned. Obviously, causes were complex and deep seated, particularly as related to the upper watershed of the high country, and to learn quantitative effects of the condition of vegetative cover would require a long-range, carefully designed program of research. However, major factors in the flood situation could be determined and described in general terms. This flood duplicated in volume of water the flood of 1894, but at that time property losses were minimal, since flood plains were not occupied or used as they were in 1948. Partly to blame was an unusual combination of climatic conditions; heavy snow in the middle and upper parts of the Columbia Basin, a late spring, and then a period of high temperatures and heavy rains. A bad fire history in the forested parts of the watershed from uncontrolled lightning fires dating from the early days, including some man-caused fires during the time of early white settlement, had left large areas with severely degraded forest cover. Moreover, unregulated grazing of public lands prior to 1908 on National Forests and later on public domain lands, coupled with repeated burning in attempts to increase forage, had badly damaged much of the high-country watershed values. Advent of organized fire control and regulation of grazing was too recent to restore adequate vegetative cover on many areas. The Corps of Engineers Columbia Basin dam building program had not reached the stage where it could contribute much in floor prevention. Grand Coulee was the only completed dam with any appreciable flood control benefits at that time.

A prophetic theme was used in the Chief's annual report for 1947; its title was "Forests and the Nation's Water Resource," and its first two textual headings were "Watershed Protection Is Vital" and "Many Watersheds Are In Poor Condition." A section entitled "Big River Floods" gave major billing to the Mississippi and Missouri and, ironically, a brief mention of a December 1945 flood on the Willamette River in Oregon, but no mention of the mighty Columbia River drainage system and its potential.

Three staff members assisted on the study of the 1948 Columbia River flood. Bullard and Tarrant studied conditions on central Washington National Forest lands contributing to runoff into the Columbia River drainage, and Stevenson of the La Grande staff worked with Beedon of the Whitman National Forest in a survey of watershed conditions in the Blue Mountains and Wallowas. A small amount of flood control funds was allotted to the Station to cover costs of this study. However, the following fiscal year, a substantial sum was allotted to the Station to renew the flood control survey project.

The forest soils program, now 2 years old at the Station, had passed through the period of program building by the fall of 1948. Some results of initial studies had been published and foresters of the region were becoming much interested in this subject. Largely at the instance of the Station, a meeting was held in September to discuss the importance of learning more about forest soils and the need for a coordinated program of research. An organizing committee of three members was named by the group.[20] The body was named "Forest Soils Committee for the Douglas-Fir Region." An action committee of seven members was set up; membership included Isaac and Tarrant.

Station soil studies were centered on soil and site factors influencing natural and artificial ponderosa pine regeneration in central Oregon. This included a study of the moisture-holding characteristics of the pumice soil profile.

Forest Management Research had an extremely active year during 1948 in many respects. Increase in funds for fiscal year 1949 permitted expansion in numbers and staff of the research center organization. Centers were defined. Six centers were now established in field headquarters, manned, and more appropriate names selected. These were: the Deschutes Center located at Bend, Oreg.; the Wind River (low Columbia) Center at Wind River, Wash.; the Puget Sound Center at Olympia, Wash.; the Siskiyou-Cascade Center at Roseburg, Oreg.; the

20 Members were Clarence Richen, Crown Zellerbach Corp.; William Hagenstein, Industrial Forestry Association; and Dean Gordon Marckworth, College of Forestry, University of Washington

Willamette Center at Corvallis, Oreg.; and the Blue Mountian Center at La Grande, Oreg. Edward S. Kotok was transferred from Region 6 in June 1948, and he established the Roseburg headquarters in preparation for initiating studies of the pressing forest management problems in southwest Oregon. This subregion contained a complex of forest conditions arising from a great range in climatic, topographic, and soil factors. The subregion includes parts of three mountain complexes—the Cascades, Siskiyous, and Coast—and two interior valleys, the Umpqua and the Rogue. It is characterized by an unusual mixture of types and species not occurring in other parts of the Douglas-fir region. On the coastal portion of the Siskiyou-Cascade subregion, Port-Orford-cedar was an important conifer species. Two hardwoods, tan oak *(Lithocarpus densiflorus)* and Oregon myrtle[21] *(Umbellaria californica),* were of some importance commercially. In the southern interior of the subregion, ponderosa pine was a significant part of the forest species composition. Sugar pine also occurred in sufficient quantities in some areas to be a characteristic species.

The Port-Orford-Cedar Experimental Forest was reactivated in 1948, and George A. James, appointed to the Station in July, was placed in charge.

Other personnel added to the Forest Management staff in the fall of 1948 were Elmer W. Shaw, attached to the Puget Sound Center, and William I. Stein, stationed at Wind River. Both these men were recruited from Region 6 National Forests.

During 1948, the Blue River Experimental Forest was formally established on the Willamette National Forest in western Oregon. Blue River flows into the McKenzie River, a major tributary of the Willamette. Addition of this experimental forest provided opportunities for expanding field tests of old-growth Douglas-fir management methods to typical conditions in the Oregon Cascades. At this point, there remained about 9 million acres of old-growth timber in the Douglas-fir region, after about a century of some timber cutting and a half century of fairly heavy exploitation. Considering that the total commercial forest land area in the region was 26 million acres, it is clearly evident that management of old-growth was a high-priority problem remaining for research attention. Little of the remaining old-growth area was suitable for conversion to agriculture or urban use. For over three decades, small plot studies of cutting methods (both clearcutting and partial cutting), artificial and natural regeneration, growth and yield, and protection against fire, insects, and disease had been made by the Federal forest research agencies and educational institutions. An impressive body of information had been collected but much remained to be learned. No simple single system of managing these forests had evolved. It was time that what had been learned should be tested in commercial-size operations. The Blue River Experimental Forest offered an opportunity to do this, and accordingly a 10-million-board-foot harvest cut was laid out in 1948 to be put up for sale early in 1949. One of the problems needing solution was determination of optimum size of clearcuts using the staggered setting system.

In cooperation with the National Forest, several other commercial-scale harvest cutting sales were planned during 1948 for study by the Station staff, including one on the Port-Orford-Cedar Experimental Forest on an area that had been high graded for the cedar.

During 1948, a preliminary tree classification was developed for use in growth studies and in partial cutting.

The program of studies of second-growth Douglas-fir management moved ahead. Applications for two additional cooperative experimental forests were received that year. The newly organized second-growth management committee was proving very effective in expanding work in this field. A manual of second-growth management prepared in 1947 was multilithed and distributed in 1948. Also during 1948, an abbreviated simplified version of the manual was prepared for distribution to owners and operators of farm woodlots and small timber tracts.

21 Commonly known in the literature as California laurel. Oregonians persist in calling this tree Oregon myrtle, and many provincials maintain it grows only in Oregon and the Holy Land. Actually, it flourishes the length of coastal California and in southern California is commonly called the bay tree.

Stand improvement thinnings on a commercial scale were made in 110-year-old spruce-hemlock stands at Cascade Head and in a 90-year-old Douglas-fir stand at the Fall Creek sale on the Willamette National Forest. Both horses and tractors were used in logging the Cascade Head sale.

Stand improvement thinnings and pruning of selected crop trees were made on the Voight Creek Cooperative Experimental Forest to determine costs and returns of such practices.

Isaac and Silen gave increased attention to direct seeding in an effort to speed up reforestation of the large area of deforested and poorly stocked burns and cutover land, which had accumulated to a total of nearly 6 million acres in the Douglas-fir region. Principal efforts were devoted to development of a hand seeder which would rapidly plant one seed at a time to a selected depth. During the 1947-48 school year, Silen was on educational leave, earning a M.F. at Yale. During this time he studied the effect of pelleting processes upon germination of the seed. He found that conventional methods inhibited germinative capacity and he developed a new process to correct this condition for trial in this region.

At this time, Weyerhaeuser, Crown Zellerbach, and Oregon State Department of Forestry were testing aerial seeding, using both fixed-wing airplanes and helicopters. Also, new rodenticides were being tried to reduce losses from seed-eating rodents. The State of Oregon was particularly interested in direct seeding as a less costly method of reforesting the Tillamook Burn. A large part of this area was moving into State ownership through reversion from tax delinquency. The Station's silviculturists cooperated in these large-scale tests of direct seeding, particularly in the planning phases.

Thornton Munger, who had been appointed as a collaborator, summarized the results of 35 years of tests of exotics at Wind River in an article entitled, "The Wind River Arboretum from 1912 to 1947," for the Arboretum Bulletin of the University of Washington.

The section of applied forest management headed by Matson centered its activities on getting forestry in the logging plan, which included layout of staggered settings and roads with consideration of the silvicultural, mensurational, and fire prevention objectives. This policy was followed on the experimental cutting operations undertaken by the Station currently confined to the Douglas-fir region. Matson also worked with Regional Office and National Forest personnel in developing and testing timber survey methods aimed at providing information for application of this principle in preparing sustained yield management plans.

Repeated tests of light selection cutting in the pine region were demonstrating that this system was the most effective way to convert virgin ponderosa pine forests to a net growth condition. Experience of the past decade has proved the value of the Keen tree classification and the Salmon-Bongberg risk rating.

The John Day Experimental Forest and Range (formerly Blue Mountain) was reactivated in 1948. A comprehensive study was initiated of management of the pine, Douglas-fir, white fir, and larch types for dual use of timber and range forage.

Growth studies of lodgepole pine were given greater attention as interest in this species grew for use in pulp and fiberboard manufacture.

Results of past fire research and more intensive fire prevention effort were paying dividends in reduction of number of fires and acreage burned in recent years. Study of the use of fire in abating the slash hazard following clearcutting in the Douglas-fir region was given top priority this year.

The forest survey benefited from the time spent the previous year in preparing detailed work plans and training personnel in the new system. During 1948, over 4.5 million acres was resurveyed in southwestern Oregon. Fieldwork on about 800,000 acres in Douglas County was made more intensive, including production of a detailed type map, through contributions of cooperators. Four timber companies and the Bureau of Land Management

contributed cash, aerial photographs, and personnel to make the inventory of these lands more intensive. On July 1, 1948, Robert B. Pope was transferred from the Northeastern Station to the forest survey staff. Pope had a special interest in photo-mensuration research.

During 1948, the Division of Forest Economics completed the report on lumber grade recovery studies made in 1947 at four small western Washington mills cutting logs from second-growth stands. Another study was made at a portable Swede gang sawmill of the Fall Creek Lumber Co., as part of the thinning experiment carried on the Fall Creek sale of the Willamette National Forest. Another study was made of costs and returns from producing lumber from logs salvaged by relogging a sale area on the Mount Hood National Forest. The material salvaged was largely understory hemlock and short fir logs remaining when the Douglas-fir overstory was removed. The study was conducted at the nearby Dwyer Lumber Co. mill in southeast Portland, minimizing log hauling costs. The Forest Utilization Service was directing major attention to reducing waste in both logging and milling operations.

At this time, considerable interest was generated among timber operators in relogging operations. Stumpage supplies were getting short near the large timber industry centers on Puget Sound, Grays Harbor, and the Columbia River. This condition applied particularly to manufacturers who had depended upon open log markets for their major raw material source. Some of the areas being relogged were originally partial cuts (so-called selective logging); others were clearcuts where only the higher grade logs were removed after felling.

The Fall Creek operation was another example of salvage logging promoted by the FUS unit. In this case, the understory hemlock was relogged with light mobile equipment and sawn in a Swedish gang mill. A second relogging operation salvaged slicing bolts from large Douglas-fir logs left after original logging because of the large amount of defect. A portable two-saw bolter mill produced clear blocks which were trucked to a box plant for manufacture of box shook and cut stock. Material unsuitable for these uses had value for manufacture of hardboard.

Economic margins were found to be slim in producing green lumber from salvage logs; although grade recovery studies showed high overruns, the product was largely common grade. Knauss of the FUS staff, a seasoning expert, worked with the industry in promoting increased dry kiln capacity for custom drying of the output of small mills. New construction of the wind tunnel type of drier promised less costly methods which would encourage greater drying of the common grads of boards and small dimension stock. Seasoning of local hardwoods was another problem tackled by the FUS in its effort to promote utilization of these species for lumber and plywood. The Oregon Forest Products Laboratory was doing considerable research in this field.

Technological developments in the softwood-plywood industry was making possible the use of lower grades of veneer. This in turn widened the raw material base. Currently, a great deal of attention was being given to utilization of material from Douglas-fir logs culled because of excessive amount of decay, a condition commonly found in logging old-growth stands, particularly in the southern Cascades. Incipient stages of decay (white speck) were being studied to determine its strength properties and use for low-grade boards and dimension. In cooperation with the West Coast Lumbermen's Association, study material was shipped to the Madison Laboratory for testing. In a few years, the Douglas-fir plywood industry found profitable use of white speck logs in making core stock and low-grade face stock.

The paper and pulp industry was also finding greater use of sawmill residues and salvaged logs in manufacture of kraft paper. Considerable new kraft pulp capacity was being installed in this region, enlarging markets for waste products of the lumber and plywood industries. The Madison Laboratory, at the urging of the Station, initiated an extensive research program to determine the tolerable amount of decay in old-growth Douglas-fir material for manufacture of high-grade kraft and semichemical pulps.

As a part of the general program of finding ways to reduce timber industrial waste, the FUS was assembling and disseminating all available information on mechanical and hydraulic log barkers. A number of different types were being installed at pulpmills, plywood plants, and sawmills.

Expansion of fiberboard plants was another development in the waste utilization activity, which was taking considerable time of the FUS personnel.

The Forest Utilization Service relied to a large extent upon personal contacts with industrial technicians and managers to produce results. Also trade and scientific journals, convention and meeting forums, and Station multiliths were used effectively. Director Hall and Matson were particularly active in this way during 1948.

January 30 and 31, 1948, the first meeting of the newly formed American Society of Range Management was held in Salt Lake City. Joe Pechanec was elected its first president, a tribute to his standing among range research and range management technicians.

Effective results of studies by the Division of Range Research in 1948 contributed to improving administration of public land forest ranges and also in planning future research programs. It was found that perennial grasses could be seeded successfully on ground denuded during timber harvest. It was also demonstrated that pelletized crested wheatgrass seed did not possess an advantage over unpelletized seed; laboratory tests showed that pelletizing greatly reduced viability. Tests of burning cheatgrass areas to reduce competition prior to reseeding to perennial grasses were successful if properly timed, although it was found that plowing would give more lasting relief from cheatgrass competition.

Sampling studies conducted in connection with experimental design for the Starkey program proved the usefulness of double sampling and subsampling.

U.S.D.A. Circular 796, “Forage Utilization On Summer Cattle Ranges In Eastern Oregon,” by Pickford and Reid, was published in September 1948.

The Range Research program was hampered somewhat by the temporary assignment of Stevenson to the emergency flood control team; the transfer of Reid to the Washington Office in August; and the detail of Harris to the statistical training course in Washington, D.C. Staebler of the Forest Management staff also attended that training session. Steele and Twerdal, of the Forest Management staff, were on educational leave during part of 1948 for graduate study at University of Michigan and Yale, respectively.

The sudden death of Sinclair Wilson on October 2, 1948, was a severe loss to the Station. Apparently in good health, he finished work on Friday and was stricken by a heart attack the next day as he was listening to a football radio broadcast. Widely known and respected throughout the Pacific Northwest for his professional accomplishments and civic contributions, he added much to the Station’s stature during his 16 years of service. Equally important were the many acts of friendship and thoughtfulness he shared with his fellow workers.

The Station’s annual report for 1949 featured the 25th anniversary of its establishment. In the introduction of the report, progress in wisely managing the forest and range resource was briefly reviewed. A short forecast of future developments resulting from Station’s findings indicated the purpose for a continuing and strengthened research program. Pointing to the contribution of the Station in training professional foresters, a partial list of some 65 currently well-known individuals was included in the report following the introduction. Many of those listed were employed elsewhere in 1948, contributing to the profession of forestry in all parts of the country.

Funds for fiscal year 1950 remained practically stationary for all Station divisions other than flood control. An increase from $7,500 to $64,000 for this activity funded the initiation of a 3-year survey of the Columbia River Basin, directed toward an intensive analysis of problems in upstream land management as a major factor in controlling excessive runoff. This was to be a cooperative program with similar survey units at the Northern Rocky

Mountain, Intermountain, and California Experiment Stations. Although this could not take the place of a basic program of scientific research in solving basic watershed management problems, it did provide an opportunity to gain experience and information in this subject matter field. It also added to the Station staff scientists, trained in watershed studies, who could furnish the nucleus for an expanded program if funds were forthcoming soon. At the beginning of the year, Bullard comprised the technical staff. In February 1949, LaVone Cable[22] was added to the clerical staff.

After the added funds became available, other personnel were added. Twerdal was the first when he returned from educational leave July 18. In October, Dr. Harold G. Wilm was transferred from the Southern Station to head the unit. Richard S. Sartz and Charles E. Hale were also obtained by transfer from the Northeastern Station in October, and in November William K. Nelson, hydraulic engineer, transferred from Region 6. Other technicians were to be added to the staff later. The last quarter of the year was principally occupied with planning conferences and meetings. Territorial assignments were made to the four Experiment Stations participating, with this Station given the responsibility for coordinating activities of all the survey sections and the preparation of an integrated overall report. Some fieldwork was commenced earlier in the year. A series of plots were established along the Mount Hood highway, on the Wind River Experimental Forest, and along the Snoqualmie Pass highway in Washington to study frost occurrence under varying forest types, stand density, and differing logging treatment. The study covered both west-side and east-side vegetative zones.

Three tributary watersheds were selected on Lookout Creek of the Blue River Experimental Forest to use in a longtime study of the effect of timber cutting on streamflow.

Complete conversion to the continuous inventory system, adoption of the new manual specifications, adverse weather, and increased travel costs slowed progress of the 1949 Forest Survey reinventory program.

Encouraging results were obtained from photo-mensuration studies commenced during the year and plans were made for expanding these studies in following years. Wilson conducted two short courses in photo interpretation for foresters. One was held at Corvallis in cooperation with Oregon State College, and the other was held in Missoula, Mont., in cooperation with Region 1 and the Northern Rocky Mountain Station.

The Station conducted a canvass of 1948 lumber production in Oregon and Washington in cooperation with the West Coast Lumbermen's Association and the Western Pine Association. For the previous few years, the Census Bureau no longer allotted money to the Station to defray the cost of making the census. The Station also acted as an intermediary between Regions 2, 3, and 4, the California and Northern Rocky Mountain Stations, and the Western Pine Association in canvassing lumber production in the remaining Western States.

During 1949, a lumber grade recovery study was made on second-growth ponderosa pine as part of a thinning study underway at Pringle Falls. Sample logs were also selected from this operation for shipment to the Forest Products Laboratory at Madison to test the physical properties of lumber produced from second-growth pine.

The Divisions of Forest Economics and FUS also cooperated with the Oregon Forest Products Laboratory in a study of lumber grade recovery from defective logs at the Valsetz Lumber Co. mill not far from Corvallis. Assistance was also given the Harbor Plywood Co. at Grays Harbor in a veneer grade recovery study comparing peeler logs from southern Oregon and southwestern Washington.

The Forest Utilization Service continued to focus attention of research agencies on forest products utilization problems across the board and to foster early industrial application of results obtained from forest product laboratories' programs. This unit cooperated closely with the Oregon Forest Products Laboratory, Oregon State

22 In 1950, LaVone Cable returned to Region 6 and later became secretary to the Regional Forester until her retirement in May 1974.

College, the University of Washington, Washington State College, the Institute of Forest Products of the State of Washington, the Pacific Northwest Wood Products Clinic, the Forest Products Research Society, and local dry kiln clubs in addition to the Madison Laboratory.

Considerable progress was being made in the use of glued-laminated wood structural members, stimulated by release of new strength values by the Forest Products Laboratory during the year. The tests were made at Madison on full-size beams of commercial quality in cooperation with the National Lumber Manufacturers Association and the industry.

Red alder, the leading hardwood species of the Pacific Northwest in timber volume, was being viewed as a potential source of pulp logs. The Madison Laboratory initiated a study of the suitability of this species for semichemical and kraft pulping.

The alcohol plant at Springfield, Oreg., was coming to life through a lease to the newly formed Oregon Wood Chemical Co., which proposed to produce wood molasses for stock and poultry feed.

Director Hall presented a paper on "Wood Fiber—Creatable Resource of Wide Utility" at the Plenary Session of the United Nations Conference on Conservation and Utilization of Resources, held at Lake Success, N.Y., in the fall of 1949. He also prepared a paper on "Development of Integrated Forest Utilization," which was read at a FAO meeting in Brussels, Belgium, the latter part of August 1949.

Forest Management Research activities continued to expand. Two new cooperative experimental forests were established; the Hemlock on lands owned by St. Regis Paper Co., in the Washington coastal area north of Grays Harbor, and the Hood Canal Experimental Forest in Kitsap County, Wash., in cooperation with Pope & Talbot Lumber Co. Other test cuttings on several new locations on National Forest lands were initiated, and numerous small plot studies were conducted throughout the region on both private and public lands with major emphasis on applied research. The objective in these activities was to find prompt and reliable intermediate answers to the most pressing problems in managing both old-growth and second-growth stands in the Douglas-fir region. At the same time, the fundamental study installations would furnish future basic information necessary for truly intensive forest management practices.

In January 1949, G. Lloyd Hayes was added to the staff to head the Siskiyou-Cascade Research Center. In March of that year, James E. Sowder was transferred from Region 5 of the Forest Service to head the Deschutes Research Center and Steele returned to Wind River from educational leave. An active institutional and in-Service training program was an established policy of the Station by this time. Station personnel were attending administrative and resource management week-long sessions the Region was conducting at Wind River. In addition, a policy had been adopted of detailing technical field men for short periods to research centers other than their own. Dahms attended the 3-month statistical seminar in the Washington Office, and Ruth was on educational leave for graduate study at Oregon State College the last 4 months of 1949.

The beginnings of a multidiscipline approach to Station projects were developing through assignment of men from one subject-matter division to assist on projects of other divisions to utilize special skills or to overcome logistic problems. Teamwork might better describe this stage. Regardless of nomenclature, it was a significant change from earlier years when an individual worked alone or with technical assistants within comparatively narrow limits of inquiry instead of working with his peers on all phases of a problem.

The thinning studies on the cooperative experimental forests, at Wind River, and on the temporary experimental areas on the National Forests, were producing quantitative results of immediate value in second-growth Douglas-fir management. A range of age classes and site conditions was covered. One of the objectives on some of the areas was the reduction of mortality from *Poria weirii,* a root rot that was a severe problem in many second-growth Douglas-fir stands. In other thinning studies, regeneration through clearcuts of brushy and poorly stocked patches

found in many stands was an objective. General objectives were to establish a road system, return a fair profit to the operator and a reasonable return to stumpage, and, of course, stimulate the increment of the highest quality trees for future harvest.

The Station's Douglas-Fir Second-Growth Management Committee continued to advise on the program and cooperate in putting study findings in practice through prompt publication of interim results. For example, during 1949 the group revised the manuscript, "Your Trees—A Crop, How to Grow and Harvest in the Douglas-Fir Region." This was designed to serve nontechnical operators and owners of small timber tracts. Arrangements were made for the forestry departments and forest schools of Oregon and Washington to print and distribute a plentiful supply of this publication in 1950.

Management studies of second-growth spruce-hemlock expanded at Cascade Head with two additional sales made to test intermediate harvest and regeneration cuttings. The cuttings were designed to test hypotheses based upon some 40 years of silvical studies of these species with the objective of learning the optimum method of obtaining satisfactory regeneration of comparatively small clearcuts. At the same time, differing sizes of setting, logging methods, and marginal windfall on clearcuts was being investigated.

With the reactivation of the Port-Orford-Cedar Experimental Forest, study of the silvical characteristics of young cedar was commenced in order to find management methods for perpetuating this valuable species in mixed stands of Douglas-fir and other rapidly growing species. Studies by Isaac and other silviculturists had shown this species to be a prolific seeder and more tolerant than Douglas-fir, but a relatively slow grower under heavy shade, offsetting its superior tolerance. It also was apparently preferential food for browsing deer.

Studies of old-growth Douglas-fir management at the Wind River and Blue River Experimental Forests and at temporary study installations on several west-side National Forests were producing an abundance of information on effects of varying cutting practices. With this information and the accumulated silvical data, it was hypothesized that a highly flexible system of both staggered-setting clearcuts and stand-improvement partial cuts was needed to meet the varying silvical conditions and silvicultural objectives in converting virgin old-growth Douglas-fir stands to thrifty managed stands. Aufderheide described detailed objectives and procedures for attaining them in an article, published in the March 1949 issue of The Timberman, entitled "Getting Forestry Into The Logging Plan." Public interest in this and other publications by Briegleb, Matson, Staebler, and Worthington were proving the value of the Station's emphasis upon applied forest management. Show-me trips to the Station's various Experimental Forests were also proving an effective means of currently circulating the Station's findings among industrial foresters, forest educators, and the timber industry.

Work, started early in the Station's history at Wind River and elsewhere in experimental plantations, demonstrated the presence of superior strains of Douglas-fir and ponderosa pine and that these strains had specific climatic limitations. Isaac's "Better Douglas-Fir Forests From Better Seed," published during 1949 by the University of Washington Press, was based upon these findings.

Reactivation of the John Day Experimental Forest in eastern Oregon was marked by construction of access roads and layout of a series of cutting tests covering some 350 acres of mixed stands of ponderosa pine and other conifers. One objective of the program was to study effects of cutting upon forage and problems of converting forest to range. A preliminary study of pine needle blight *(Elytroderma deformans)* was made in cooperation with the office of Forest Pathology.

A second series of experimental cuttings was completed in the 105-year-old stand of second-growth ponderosa pine on the Lookout Mountain addition of the Pringle Falls Experimental Forest. Indications were found of decay resulting from bark beetle attacks in these stands which introduced a new factor in marking trees for cutting. Followup studies of this problem were planned in cooperation with the forest pathologists.

The Station published Mowat's "Preliminary Guides for the Management of Lodgepole Pine in Oregon and Washington" in 1949 as a Research Note.

Willard H. Carmean returned to the Station from educational leave and was added to the Forest Management staff on a permanent appointment as a soil scientist. He was assigned to a study of physical factors of soil and site as they influence Douglas-fir growth. Numerous soil problems were being identified and described. With two men on the job, plans were made for expanding the program. Tarrant outlined the program ahead in an article published in Northwest Science, "A Program of Forest Soils Research For the Pacific Northwest."

Despite the lack of a project leader for forest mensurational studies, considerable progress was made during 1949. For the third summer, Professor Barnes of Oregon State College continued work on western hemlock yield tables and completed a preliminary draft. Johnson of the forest survey staff also worked part time on mensuration studies and produced several articles on sampling techniques for technical periodicals.

Donald Bruce, of Mason, Bruce, and Girard, assisted the Station in revising U.S.D.A. Technical Bulletin No. 21, "The Yield of Douglas-Fir in the Pacific Northwest," which was reprinted October 1949.

Briegleb summarized available information on "Growth of Ponderosa Pine' for presentation at the national meeting of the Society of American Foresters. Briegleb also presented two papers at a Forest Service management planning conference held March 28-April 8, 1949, at Hot Springs, Ark. Subject of one paper was, "The Use of Yield Tables in Predicting Growth, Mortality, and Yield," and of the other, "Methods of Management and Methods of Regulation of Cut in the National Forests of the North Pacific Region."

The Station cooperated with the Regional Office and the Willamette National Forest in a methods-of-cruising study with the objective of finding ways to shorten the cruising job required for timber sale appraisals of old-growth Douglas-fir.

The appointment of Owen P. Cramer, forester-meteorologist, in January 1949 greatly strengthened the fire research staff in number of personnel and in skills.

To take a critical look at forest fire research objectives and to keep abreast of changing conditions, a forest fire research advisory committee was organized. The first meeting was held at the Station in Portland on July 28, 1949. In attendance were representatives of the State Foresters of Oregon and Washington, the private forest fire associations, timberland owners, the National Forest Administration, and Hall, Briegleb, Morris, Hayes, and Cramer. The charter of the committee was to review, periodically, status and problems of forest fire control in the region and advise on Station's research programs and study priorities.

Clark E. Holscher transferred from the U.S. Sheep Experiment Station at DuBois, Idaho, in June 1949 to head the Blue Mountain Research Center. Funds were still a problem in completing the road and fence development program at Starkey, delaying the studies planned for a series of 12 pastures. However, it was an ill wind, etc., etc., as the additional time was well spent on developing better methods of sampling vegetation and refining working plans.

In a Westernwide initial test of the "pin point" transect, a modification of the technique named the "loop transect" was developed. Pechanec, Holscher, Garrison, and Harris participated in this test led by Kenneth W. Parker of the Washington Office. Fred Kennedy and Floyd Iverson of National Forest Administration were the other participants.

The Blue Mountain range staff and Rummel from Wenatchee cooperated with Miss Doris Hayes of the Division of Dendrology and Range Forage Investigations in initial fieldwork for a summer and winter key of important east-side range shrubs.

The year 1949 was also an anniversary year for the Forest Insect Laboratory. From the time of its establishment in Portland 20 years before, it was headquartered in neighboring offices to the Station. Its staff was closely associated with the Station staff, and much of its work was done in cooperative projects with the Station.

It was appropriate that this year a resume of the forest insect investigations of the Laboratory was included in the Station's Annual Report, 1949, for the first time.

Although forest insect research in the Pacific Northwest had been underway about a half a century, it was on a limited scale for some 30 years, and largely devoted to giving technical services to bark beetle control projects in the ponderosa pine region. In the late 30's, indirect control methods were developed through studies by the entomologists and silviculturists which recognized and removed high-risk (insect susceptible) trees from the stands in light selection cuttings. Following World War II, emphasis shifted to direct control of coniferous defoliators and fir bark beetles.

The Forest Pest Control Act of June 29, 1947, was landmark legislation which stimulated forest insect and disease research and which gave a major boost to control programs. Appropriated funds were increased and the laboratory staff was enlarged. In 1949, the technical staff, headed by R. L. Furniss, included John M. Whiteside and William K. Coulter, entomologists, John F. Wear, pilot-entomologist, Walter J. Buckhorn and Kenneth H. Wright, scientific aides.

In 1948 and 1949, spruce budworm surveys, control, and research were major activities, and in the summer of 1949 over a quarter of a million acres of Douglas-fir forests infested by the budworm were sprayed by air with DDT (no environmental statement was required then). This was a joint control project of the State of Oregon and the Forest Service. The Laboratory gave technical supervision and checked results of this project. The project was considered successful and was expanded the following year. At the same time, basic research was being conducted on this damaging insect, mainly directed toward parasitism as a biological control measure.

Other research included studies of the fir engraver beetle and the Douglas-fir bark beetle.

Outbreak of the Korean war in 1950, although not as severe as World War II, had an impact on the Station's programs and personnel. Two reserve officers, Tarrant and James, were called to active duty. Floyd Johnson, the Station's statistician, was detailed in July to the Military Forest Products Requirement Project, headquartered in Alexandria, Va. This project was undertaken by the Forest Service for the Defense Department. Funds for fiscal year 1951 were reduced for all activities with the exception of flood control. Flood control funds were increased some 45 percent over the previous fiscal year. However, this Station's responsibility for coordinating all flood control survey activities in the Columbia River Basin, in addition to specific area survey assignments, absorbed the additional funds. The Station also received an allotment of Defense Production funds for war-related projects assigned to it.

Robert L. Hobba was added to the flood control staff by transfer from the Southern Station in April 1950, completing a staff of seven full-time professional personnel. At this time, the Department was engaged in making a comprehensive survey of the land and water resources of the Columbia River Basin and preparing a program for the development, utilization, and conservation of these natural resources. This was an interagency undertaking and Department field committees were organized to prepare a coordinated program. The Forest Service was represented on these committees to develop the forestry-related phases of the problem and to coordinate and integrate them with agricultural and nonagricultural basin programs.

At this time, similar studies were being conducted on the Missouri River Basin in the West and a number of important Eastern and Southern river drainage systems. The Forest Service prepared a series of reports on forest resources and related problems for the major drainage basins of the country for the Water Resources Board. Cowlin was detailed to the Washington Office for 2 months to work on these reports and to act as a liaison officer between the Forest Service and other U.S.D.A. agencies on this project.

The flood control survey responsibilities were: (1) to determine the incidence and extent of damage from floods, erosion, and sedimentation; (2) to locate sources and causes of floods and erosion; (3) to develop a program of land management and improvement that would reduce these losses to tolerable levels; and (4) to make a cost-benefit analysis of program recommendations.

The flood control survey staff had the entire responsibility for making damage appraisals, hydrologic analyses, studies of past and present conditions, preparation of programs for sample areas on the portion of the Basin assigned to this Station, and coordinating overall similar assignments to other Forest Experiment Stations involved. They also worked with the Administrative Branch of the Forest Service and the U.S.D.A. Field Committee in assembling and analyzing information on present physical, biological, and economic conditions in the Basin and in reviewing program proposals.

During 1950, progress was made in basic watershed management research. Studies were initiated on several experimental forests and ranges. At the Blue River Experimental Forest, where research in forestry measures for managing an entire drainage or working circle were underway, watershed management objectives were an integral part of the program. Operational-sale tests of how roadbuilding and logging affect erosion and stream-flow were included. Plans were completed for a watershed study of three matched watersheds on the forest. Alternative cutting methods were tested on the Lookout Creek unit of Blue River to determine the best methods of streamside protection in logging.

Preliminary studies and observations on this Experimental Forest and other cutting areas showed that most stream sedimentation came from roadbuilding and road use. Road layouts on the Blue River Forest were being planned to minimize stream sedimentation. Likewise, location of settings and yarding methods were planned with similar objectives.

Now, as then, much of the remaining old-growth Douglas-fir is located on rough topography, and road and logging costs are high and potential soil damage is a serious factor. This demands making a detailed logging plan, prior to initiation of operation, of a drainage or logging unit, giving consideration to both cut and leave settings and to all the forest and watershed management objectives as well as economic and engineering considerations.

Regeneration studies were given a boost by the assignment of an additional man by the Fish and Wildlife Service. Chief emphasis was placed upon control of seed-eating rodents by poisoning and tests of the effect of time and method of broadcast seeding. A seed storage study underway in cooperation with the Boyce Thompson Institute for the past 4 years had demonstrated that seed of all regional conifers, except western redcedar, stored well at 21°F.

Generally speaking, forest management studies after 4 consecutive years of expansion declined in strength during 1950. Coupled with reduction in allotted funds, the increase in cost of goods and services and loss of personnel to the military and other duties were adversely affecting the overall program and prohibiting the initiation of many new studies needed to solve the continuously developing problem as forest management practices were applied on private and public forest lands.

With Tarrant's recall to the Navy, the forest soils studies suffered. However, good progress was made on going studies. Carmean completed fieldwork on soil factors related to site and growth rate of Douglas-fir, but at the end of the year, he returned to Duke University to resume his graduate studies. He planned on taking the field data with him for laboratory analysis and computation of results as part of this graduate program.

A study of foliage nutrient content of representative Pacific Northwest species, commenced in 1941, was completed this year. This study included measurement of major nutrient elements in the foliage, which was done cooperatively with Dr. Robert Chandler of the University of New Hampshire.

Studies on the Experimental Forests the past few years had demonstrated the value of soil surveys in management planning, including road layout and cutting operations. It was found on a study on the Voight Creek Experimental Forest that current soil classification units were inadequate for intensive management use and that a more relevant forest soil classification system was needed in the Douglas-fir region.

Second-growth management in the Douglas-fir region continued on a productive scale on the Experimental Forests. The McCleary Cooperative Experimental Forest was being developed and maintained entirely from sale of timber products removed in the initial cut. A part of this forest was set aside as a demonstration area for farm woodlot owners.

During 1950, first stand-improvement cuts were made on the newest cooperative Experimental Forest, the Hood Canal, on Pope & Talbot Co. land and on the Hemlock Experimental Forest in cooperation with the St. Regis Paper Co.

Experimental cutting in the 110-year-old Douglas-fir stand on the Panther Creek unit of the Wind River Experimental Forest was about half completed. Serious infections of *Poria weirii* root rot led to the objective of finding better indicators of such infections. Childs, of the Forest Pathology staff, developed the hypothesis that this root rot more commonly occurs in pure stands that succeed pure stands of that species, indicating the solution of converting the area to stands of mixed conifers.

Following 3 or 4 years of cutting operations on Station Experimental Forests, including clearcuts with staggered settings and intermediate cuts, difficulties developed in getting satisfactory research results under the regular National Forest timber sale procedure. It was decided to test the method of handling sales through cooperative agreements with a selected operator. Accordingly, an agreement was made with the Publishers Paper Co., with the expectation that this arrangement would facilitate applied forest management cutting studies. This company was operating on their own land in this general area and had a going sale of some 8 million board feet at Cascade Head under the regular procedure. Having an interest in spruce-hemlock management, the company agreed to contribute $5,000 annually to augment research in various logging methods and cutting practices.

Supporting the applied forest management program in Douglas-fir, Matson wrote three reports giving results of grade recovery studies of lumber from second-growth Douglas-fir.

The principal activity in pine management research in 1950 was initiation of two experimental cuttings. One was at Pringle Falls, a sanitation salvage light cut removing some 1,400 board feet per acre from about 3,500 acres. The other was a first-step sanitation-improvement cut in a mixed pine-fir stand on the John Day Experimental Forest. Ponderosa pine needle blight was reaching epidemic scale on this forest, and plots were established in cooperation with the Office of Forest Pathology to learn how to early identify infested trees and to determine extent and trends of the epidemic.

The mixed-conifer types of southwestern Oregon had received little past attention and they presented a complexity of problems. The forest survey completed the computation and analysis of the reinventory of the five counties comprising this subregion in 1950. It showed the area had over 150 billion board feet, Scribner scale, of sawtimber. Here, 1.4 percent of the Nation's commercial forest land was supporting 10 percent of its total sawtimber volume. Since World War II, cutting had expanded rapidly in the area, and it was imperative that forest management research programs be stepped up to meet critical problems. A field meeting, the first held in southwestern Oregon, brought together administrative and research personnel to study problem areas and discuss remedial measures and research program priorities. The meeting was held on the Umpqua and Rogue River National Forests, and was attended by representatives of the Portland Regional Office, the Umpqua, Rogue River, and Siskiyou National Forests, the Pacific Northwest and California Forest Experiment Stations, and, since sugar pine was an important species here, the Office of Blister Rust Control.

Personnel changes were a large factor in program reductions in forest management research during 1950. Aufderheide transferred to the supervisorship of the Umpqua National Forest in February, and Harold Rapraeger resigned in May, forcing the closing of the Corvallis headquarters of the Willamette Research Center. Ruth completed a year of graduate work at Oregon State College in June, and in September Dahms left for graduate work at Syracuse and Staebler for the University of Michigan. In early September, Hayes left for a 4-month special detail in California.

With the increased cost for salaries, travel, and supplies and more intensive standards, the unit cost of areas inventoried by the forest survey had also increased, despite the progress made in refining survey techniques. Accordingly, greater emphasis was given in techniques research in 1950. The objective was to find means to integrate and apply sophisticated statistical and photogrammetric techniques to forest inventories. Considerable progress had been made in the past year in substituting photo mensuration plots for field plots. The survey group were also cooperating with the BLM and the forest entomologists and pathologists in an evaluation of ground and aerial photo techniques for estimating tree mortality.

The Forest Utilization Service was placing added effort to problems developing in utilization of second-growth Douglas-fir. The problem of seasoning performance of lumber from second-growth Douglas-fir was given priority to develop the best drying practices. This problem was complicated by the fact that much of this lumber was being produced by small mills without the resources to install conventional dry kilns and steam boiler plants. Production of plywood from second-growth Douglas-fir was also beginning for such uses as sheathing and other lower value products.

A cooperative study comparing the properties of second-growth and old-growth Port-Orford-cedar was completed at the Oregon State Forest Products Laboratory. In addition to the FUS, the Madison Laboratory cooperated on this project.

The Forest Products Research Society held its annual convention in Portland this year. Dr. E. J. Locke of the Station was president of the Society of this term.

Pending completion of the physical improvements and research facilities at Starkey Experimental Range, research effort was concentrated on gaining a better understanding of the soil and vegetative cover and changes which had occurred since the area was first surveyed in 1939. Refinement of techniques continued, and a subsampling system was devised and tried in one pasture during 1950. Working well, the system was planned to be used in all pastures for collection of experimental data.

Upon examination by Dr. Wilm, it was found that drainages in six of the pastures were adapted for watershed studies, permitting integration of range influence studies into the overall grazing management study at Starkey.

The nursery phase of range reseeding research at the Swauk Nursery commenced to produce significant results. Since establishment in 1946, 130 strains representing 73 species of grasses, legumes, and shrubs had been tested. Ratings made in 1949 showed that 54 percent of the accessions rated good or better compared with 34 percent rated poor or failures. This indicated that many species could be used in reseeding similar sites in the ponderosa pine zone east of the Cascades. Strain differences within species were as marked as differences between species.

CHAPTER V. Growth of the Research Centers and Initial Development of Subregional Laboratories—1951-63

There were a number of significant events during 1951, some of which interrupted orderly progress of research programs during the year.

The national rearmament program continued to draw heavily upon the Forest Utilization and forest survey staffs, although many other staff personnel also contributed some time to this "emergency" activity. The principal projects undertaken were surveys of log equipment, supplies, and manpower, and analysis of the adequacy of raw materials for timber industries applying for "certificates of necessity" from the National Production Authority. During the comparatively short interval between the end of World War II and the outbreak of the Korean war, the Station's research program had expanded in scope and intensity and an extremely capable and experienced staff developed at this Station, a tempting target for personnel "head hunters." As a consequence, personnel moves became numerous, involving a number of key positions. On April 1, 1951, Director J. Alfred Hall moved to the Madison Laboratory, succeeding George M. Hunt, the retiring director. Robert W. Cowlin was appointed as Hail's successor. Arthur W. Greeley, supervisor of the Lassen National Forest, Region 5, was transferred to this Station as assistant to the Director in July and put in charge of the Division of Forest Economics. On July 1, Edward G. Locke transferred to the Madison Laboratory as Chief of the Division of Derived Products and Elmer E. Matson was appointed his successor as Chief of Forest Utilization Research here.

August 1, Philip A. Briegleb was promoted to the directorship of the Central States Station at Columbus, Ohio, and George S. Meagher was transferred from the Southwestern Station to Portland on August 11 to fill his position as Chief of Forest Management Research.

Harold C. Wilm, Chief of Flood Control Surveys, was transferred to the Washington Office November 1 to become Chief of the Division of Forest and Range Influences, succeeding Edward N. Munns who retired. The position Wilm vacated was filled by the transfer of Martin E. Baudendistel from the Northern Rocky Mountain Station.

Within a half year's time there was an unusual turnover in the top positions of the Station. The only division unaffected by personnel changes was Range Research; however, during this year, Pechanec was on a 4-month detail, commencing in August, to join a four-man FAO (United Nations) mission to Somaliland as a range management and animal husbandry specialist.

In one sense, this was a recognition of the outstanding caliber of the Station staff that moved on to prominent new posts and a tribute to the remaining staff that carried on and produced creditable accomplishments during 1951. This record was further advanced by the high qualifications of the men selected to fill the top vacancies. Return of Floyd Johnson from the Washington Office in July filled a void in the forest mensuration program. It was fortunate that through the cooperation of Donald Bruce and Professor George Barnes, the forest mensuration program was maintained on a functioning basis for the past several years.[1] Several notable new appointments were made. Carl M. Berntsen and Henry J. Gratkowski were given probational appointments to the Forest Management staff, and Marjoree K. Hysmith and Helen Rastovich[2] were added to the clerical staff in the late summer. Berntsen was assigned to Cascade Head and Gratkowski to the Blue River Experimental Forest.

1 Edgel C. Skinner, a college-trained mathematician and statistician, appointed July 1, 1948, as a statistical clerk, did much to keep this important activity moving. On January 1, 1953, she was reclassified as an analytical statistician, more appropriate for her capabilities.

2 Helen Rastovich is still employed at the Deschutes Research Center, although she is now Mrs. James Barrett.

The Station lost a valued associate and friend in the tragic death of Horace ("Hoss" J. Andrews on Easter Eve, March 24, in Washington, D.C. Andrews, Hall, and Cowlin had arrived in Washington a few days earlier to attend the annual Regional Foresters and Directors meeting. Regional Forester Andrews had made an exceptional record in Region 6 and was scheduled to succeed Assistant Chief C. M. Granger in charge of National Forest Administration upon his impending retirement. It was while looking for a Washington residence in anticipation of this move that he was killed in an automobile accident.

Floss Andrews commenced his Forest Service career at the Station, and it took pride in his accomplishments and valued his friendship and professional counsel. An outstanding forest administrator, he had a keen appreciation and understanding of forest research and its important place in the Forest Service.

J. Herbert Stone, Regional Forester of the Southern Region, was appointed to succeed Andrews in Region 6, arriving in Portland in mid-May 1951.

This year brought Leo A. Isaac; distinction from his alma mater. He was accorded the Outstanding Achievement Award by the University of Minnesota on May 25.

The forest survey got off to a late start on the reinventory program this year, as Moravets was giving nearly full time to defense activities during most of the year. Other staff members were also engaged in related service activities. Considerable attention was given to the cooperative forest mortality study program and other techniques research.

Art Greeley, in addition to taking charge of the division's study program, contributed to the work of the Douglas-fir Second-Growth Management Committee in issuing a revision of the 1947 publication. The success of this committee, the Forest Soils Committee, and the several other cooperative projects with industrial foresters and timber operators led to the planning of an advisory committee for the Puget Sound Research Center, where much of this activity took place.

A new Experimental Forest, the South Umpqua, was formally established upon the Umpqua National Forest, representing the mixed-conifer type of southwest Oregon. Personnel changes also occurred in the Siskiyou-Cascade Research Center staff. Ted Kotok was transferred to the Southwestern Station in January 1951 to join a new Forest Utilization Service unit there. Offsetting this loss was the return of George James from military leave to the Port-Orford-cedar studies and the assignment to this center of Stein, who returned to Roseburg from educational leave. Inventory work on the 4,500-acre South Umpqua Experimental Forest commenced immediately following establishment in July.

Use of rodent poisoning to conserve natural seedfall was given extra attention since there was a full seed crop of several conifer species. Paired plots were established in cooperation with the Fish and Wildlife Service in the Siskiyou-Cascade and Puget Sound provinces and on the Wind River Experimental Forest. In the field of artificial regeneration a new device, the "Keyes screen," was tested in southwestern Oregon and eastern Oregon to protect pine seed from rodents and to protect seedling roots from cutworms.

During the postwar years, concern developed regarding the diminishing supply of peeler logs, and in response special attention was given to pruning of Douglas-fir to improve log quality of future timber crops. Two trade journal articles on this subject by Station authors were published during 1951 as a followup of the publication in 1950 of a handbook, "Financial Aspects of Pruning." In southwest Oregon, tests were planned for a study of the opportunities for strengthening blister rust control through pruning selected crop trees in young sugar pine stands.

At the Experimental Forests on National Forest and on private lands under cooperative agreements, a number of methods of making thinnings or intermediate harvest cuttings were being tested in various parts of the Douglas-fir region on a commercial basis for a range of age classes.

The Blue River Experimental Forest was becoming the center for research in old-growth Douglas-fir management and innovative tests of an engineering nature were being initiated as a part of the overall objective of planning and executing the orderly conversion of a virgin-forest major watershed to a managed forest.

For example, during 1951, timber sale layouts, based upon an aerial topographic map, were compared to layouts based upon a topographic map made by ground surveys. Preliminary results indicated a slight advantage for the aerial photo map. A study of basic principles involved in efficient planning of a system of permanent truck roads for high-lead logging in rough topography was initiated. Another innovation tried at Blue River in 1951 was the pioneering of the road right-of-way with a bulldozer before felling right-of-way timber.

Forest Management Research in the east-side forests continued to focus upon the ponderosa pine types. An account of the light sanitation-salvage cutting at Pringle Falls, made in 1950, was issued in detail late in 1951 as Station Research Paper No. 2 by Sowder entitled, “A Sanitation-Salvage Cutting in Ponderosa Pine.”

Through cooperation of the Western Pine Association, Forest Service, and Bureau of Entomology and Plant Quarantine, a greatly expanded ground and aerial forest insect detection survey was made in the pine region.

The spruce budworm was the cause of considerable concern, and during 1951 nearly 1 million acres were sprayed to control this insect in Oregon and Washington, bringing the total area sprayed with DDT during the 1949-51 outbreak to 2.1 million acres at a cost of about $2.3 million. Biological studies of this destructive insect and its natural control factors continued. From the information at hand, the control program successfully prevented serious timber losses. No evidence was found that the relative abundance of budworm parasites was upset by the spraying of DDT.

Sporadic heavy losses from the Douglas-fir bark beetle in southwestern Oregon directed increased attention to this forest insect problem. Extensive fires in the summer and fall of 1951 and heavy winds in December 1951 contributed much additional breeding material for this pest. An intensive survey was planned for early spring of 1952.

Fire weather indices devised by the Station and tested during 1951 showed this year to be the most dangerous for the past 20 years in western Oregon, as measured by indices combining drought, relative humidity, and windspeed factors.

The flood control survey group lost another key staffman with the transfer of Bill Nelson to the U.S. Navy, North Atlantic Production Board, in October of 1951. Nelson was selected for this position on the basis of special skills and experience gained while on military duty during World War II. However, he was recalled in a civilian capacity serving under Admiral Draper, functioning under the Marshall Plan and headquartered in Paris, France.

In addition to coordination of flood control survey work for the Columbia Basin program, sediment sampling in a number of streams and hydrology analyses of streamflows from a number of sample watersheds were major activities during the year. A summary report of the previous year’s sediment sampling observations was published November 1 as Research Note No. 75 by Manes Barton, forestry aide, who resigned shortly after. The final report on the soil freezing study was published in October as Research Note 74 by C. E. Hale.

The Flood Control Division was called upon by the Regional Office for help in preparing the Project Work Inventory for Region 6 National Forests. Bullard, Nelson, and Sartz spent 2 months in the field working with the district ranger to insure inclusion of necessary flood control projects in the inventory.

Wilm and Pechanec prepared a significant paper on “Patterns of Scientific Inquiry,” which was released as a Station multilith in January 1951. In February 1952, a companion article, “A Pattern of Scientific Inquiry For Applied Research,” by Wilm, was published in the Journal of Forestry.

Few new field studies in range management research were started in 1951. The work force was reduced through the resignation of Stevenson in midyear and absence of Pechanec for a third of the year. Some of the less productive studies were terminated, and other studies had reached the stage where further field observations were being reduced. Flow of publications based upon earlier field studies increased notably. The list included one departmental publication giving the results of a cooperative study with the Biological Survey on the pocket gopher, a troublesome pest in range management. The title was “The Dalles Pocket Gopher and Its Influence on Forage Production of Oregon Mountain Meadows,” U.S.D.A. Circ. 884, August 1951. A. W. Moore of the Biological Survey, the senior author, was working with Range Management and Forest Management on a number of cooperative studies. Garrison and Rummel published an article in the Journal of Forestry on the effects of logging on ponderosa pine forest rangelands in the east side, and Rummel presented a more specialized article on the same subject in Ecology. Harris contributed an article to the Journal of Range Management on the use of aerial photographs and subsampling in range inventories. In addition, division authors contributed five popular-type articles on range management methods and techniques to local farm journals. Three short Station multilith releases of the helpful hints in range management style completed the list. The policy of issuing progress reports and articles of practical nature was finding a wide and receptive audience.

A large undertaking was the completion of the final draft of the range reseeding section of the Region 6 Range Management Field Handbook, which was processed for use in July. This handbook was prepared jointly by Administrative and Research personnel.

Fiscal fortunes improved in 1952, and with dwindling diversions to defense projects and increases in regularly appropriated funds, prospects for making and following long-range plans and program development were auspicious. It was an opportune time to review past work and accomplishments and current status of the Station’s program and its relationship to public and private forest-land managers. Short-range and long-range projects and proposals were critically scrutinized, and special attention was given to strengthening and coordinating cooperative research with other public and private agencies.

The Region 6 Investigative Committee, which had not met since 1948, was revived and met in March under the chairmanship of Regional Forester Stone. With many new men in key positions at the Station and in the Region, the meeting appropriately informed them of the program status and the Station gained fresh points of view on program needs. Representatives of the Regional Office, National Forests, and other Federal agencies having forest and rangeland responsibilities, as well as Station staff members, attended and participated in the discussions. Each project was reviewed critically and profitably. Shortcomings in specific fields of work, such as forest influences, forest soils, forest genetics, the slash disposal phase of forest management and fire research, were identified and emphasized. These weaknesses stemmed largely from lack of funding.

An internal review of the program and work at the field centers by the Director and his Portland staff was initiated in 1952. During the year, comprehensive inspection of the Puget Sound, Deschutes, and Siskiyou-Cascade Research Centers and at Wind River with the objectives of improving work programs and attaining economy of research manpower. One noticeable problem was the need for employment of technical aides to relieve professionals of low-grade tasks. Inadequacy of physical facilities was also becoming apparent, particularly at the research center headquarter locations.

Another aspect of program review was developed by the formation of a technical advisory committee for the Puget Sound Research Center. The first meeting was held in Olympia February 26. The committee consisted of 13 technical foresters—leaders in private, municipal, State and Federal forestry,[3] and forestry education. Interest of committee members in reviewing the center's program and visiting field study areas led to three additional meetings of the committee during 1952. Success of this committee encouraged the formation of a similar committee for the Deschutes Center, which held an initial meeting in Bend October 31 followed by a field trip to Pringle Falls the next day. All committee members[4] were technical foresters with the exception of Phil F. Brogan, a journalist on the Bend Bulletin and an authority on the geology of eastern Oregon with a deep interest in natural resource conservation.

The Station also joined with Region 6 in selecting and organizing a Regional Forest Service Advisory Council. This group was composed of regional leaders in the economic and social structure of the Pacific Northwest representing major geographic, governmental, and economic segments of the region. This group functioned on a broad policy basis. The first meeting was held in Portland in July and the second at Wind River in October.

Although the special defense projects were virtually terminated early in 1952, another emergency project interrupted the forest survey reinventory program. Early in the year, it was becoming apparent that a serious infestation of the Douglas-fir bark beetle was developing from blowdown areas in western Oregon and southwestern Washington. During February and March, a joint aerial reconnaissance survey was made by the Portland Forest Insect Laboratory, the Oregon State Board of Forestry, and the Weyerhaeuser Timber Co. This survey detected serious infestation covering over 3 million acres and showed that emergency measures should be taken to avoid unbearable losses. The Northwest Forest Pest Action Committee, the Regional Office, the Station, and the Forest Insect Laboratory immediately acquainted the Washington Office with the gravity of the situation and proposed that an intensive survey be made to locate the infested areas which were scattered through a large area. Direct control through spraying or felling each infested tree was not feasible. However; if patches of fire-killed or blowdown timber could be located enabling the landowners to proceed with salvage operations in the major areas of infestation, it would serve as a control and prevent successive buildup of infestation. The Washington Office allotted $63,000 of Forest Pest Control funds to the Station with instructions to collaborate with the Forest Insect Laboratory and proceed with the proposed survey. Overall Leadership of the project was assigned to the Division of Forest Economics under Greeley's direction. The Oregon State Board of Forestry contributed $10,000 in cash to the project, and $11,000 in services and salaries were contributed by various organizations, including the U.S. Weather Bureau, Bureau of Land Management, and the Oregon State Board of Forestry who donated the time of four men for the duration of the project. A total of about 40 people were employed directly on the project and a number of others were involved indirectly.

The method used was direct aerial mapping supplemented by ground sampling, using plots to determine various degrees of blowdown and timber volume. Four-place Cessna 170-B planes were used, selected for slow flying speed, maneuverability, and high visibility features. The front-seat observer mapped beetle-killed groups and the two rear-seat observers mapped blowdown, using previously prepared maps with flight lines laid out at spaced intervals.

3 Original members were George L. Drake, W. B. Greeley, Philip G. Haddock, E. F. Heacox, N. G. Jacobson, W. H. Johnson, Gilbert Liming, W. J. Lloyd, Carl B. Neal, Bernard L. Orell, Allen E. Thompson, and W. A. Tinney.

4 Members were Phil F. Brogan, Kenneth A. Burkholder, Rufus W. Childre, Ralph Crawford, Roy A. Johnson, John E. McDonald, Hans C. Milius, Gail Thornas, Vondin E. Miller, Thomas J. Orr, Nicholas Welter, and Earl Wilcox.

Field headquarters were established at Eugene. Work was divided into two sections: air operations with R. C. Wilson in charge until July 24 and K. H. Wright in charge from July 25 to close of field operation on August 20, and field inventory with R. B. Pope in charge for the duration. J. F. Wear of the Forest Insect Laboratory was the chief pilot and Dan Olin of the Siskiyou National Forest was the air operations officer. Four other pilots were used, three from the Forest Service and one from the Bureau of Entomology and Plant Quarantine.

Speed was the essence of the project, and as the air crews completed a map, it was prepared for publication by draftsmen. Fieldwork took about 3 months, ending about Labor Day, and early in October finished maps were released followed shortly by a 10-page summary entitled "Summary Statement on the 1952 Blowdown-Bark Beetle Survey in the Douglas-fir Region of Oregon and Washington." The report showed that the combined loss from the 1951-52 blowdown and the 1951 beetle attacks was roughly 10 billion board feet. Prompt completion of this project was the result of combined efforts of many agencies and people. Release of information was expedited by contribution of the Soil Conservation Service and the Industrial Forestry Association who assisted in preparing and processing the reports. Organizing ability and leadership of Art Greeley provided for smooth functioning of the various cooperators and prompt completion of assigned tasks. Preparation of the final report of the 1952 blowdown-bark beetle survey commenced before the year end.

Meanwhile, under Moravets' leadership, a total of 2.5 million acres of forest land in the region was reinventoried. Some preliminary planning was also done by the division on the nationwide Timber Resource Review, which was scheduled to get underway full scale in 1953.

The forest survey lost the services of R. C. Wilson, who transferred to the Washington Office Division of Forest Economics on September 8, 1952, to take charge of a cooperative project with the U.S. Air Force. During his comparatively short career at the Station, Dick Wilson was responsible for incorporating effective use of photogrammetric methods into forest survey procedures. He also was chiefly responsible for organizing a Columbia River Section of the American Society of Photogrammetry and was the first section president. For several years, he cooperated with the Pacific Northwest forest schools in giving short courses in forest photogrammetry.

The forest survey staff recruited two new members in 1952. Benjamin Spada transferred from Region 6 April 21 and was one of the aerial observers on the bark beetle survey. Robert O. McMahon was given a probational appointment July 21.

The Forest Utilization Service initiated a cooperative study to measure the effects of seasoning tight-knotted Douglas-fir dimension from young-growth trees to moisture content levels of 18, 15, and 12 percent. Such information fits into the overall program of second-growth management of Douglas-fir stands. The study was done in cooperation with the Oregon Forest Products Laboratory, the West Coast Lumber Grade and Inspection Bureau, and several lumber companies. Knauss and John McMillen of the Madison Laboratory gave a weeklong kiln drying course at the Corvallis Laboratory. These sessions were very successful and well attended by sawmill and dry kiln equipment manufacturing employees.

The Madison Laboratory cooperated with the Oregon Forest Products Laboratory during the summer of 1952 on the first phase of a hardwood log and lumber grade study. The Corvallis Laboratory computed and analyzed the field data and planned a report for release later.

The Wyssen Skyline & Crane Co. of Switzerland demonstrated a logging system designed for rugged topography at Spillamacheen, British Columbia. Matson viewed this operation to determine if it might be used in this region on locations where road costs were excessive or where current logging systems were inadvisable owing to danger of excessive erosion. Portions of the Blue River Experimental Forest were examples of such conditions and prospective trial areas.

The return of Tarrant from military service restored the Forest Management staff to a full roster, although Silen attended the statistical seminar in Washington, D.C., during the year.

Work in planting and seeding was highlighted by the introduction of tetramine, a combined rodenticide and rodent repellant developed by the Denver Laboratory of the Fish and Wildlife Service. Methods for treating tree seed directly without appreciable loss of viability were developed for Douglas-fir and ponderosa pine. This was a promising development in direct seeding, and many agencies cooperated in the field tests. It did become the subject of controversy later. An interesting small-scale study during the year was the use of vermiculite at Wind River as a medium for germination tests and for stratification of Douglas-fir seed. This was the first time it was used in the Pacific Northwest.

Group plantings of dawn redwood *(Metasequoia glyptostroboides)* were established at six points in the fog belt of coastal Oregon and Washington. This exotic was exciting interest of dendrologists and horticulturists. Four species of *Pseudotsuga* and several strains of Douglas-fir representing the complete range of the species were obtained in cooperation with the College of Forestry, University of Washington, and group plantings were made at Wind River and the Pack Demonstration Forest. Other progress was made in the field of forest genetics in seed selection, field tests of hybrid pine, and arboretum tests. However, the Station still lacked a coordinated long-range program of forest genetics owing to lack of financing.

The brush problem following clearcutting, particularly in the coastal areas where a long growing season and abundant moisture encouraged rapid growth of aggressive shrubs hindering natural reproduction and plantings, demanded attention. Tests of brush control were made at Henderson Creek and Cascade Head, including spray with selective herbicides.

Animal damage was another regeneration problem that was becoming more apparent. A survey of animal damage on Weyerhaeuser's Clemons Tree Farm showed that in a mixed-conifer plantation about half the trees were deformed during the first 4 years. The Station cooperated with the company and the Fish and Wildlife Service in a study of the problem; deer and rabbits were found to be the principal culprits.

Cooperative funds from the Publishers Paper Co. made possible a study of the pattern of marginal windfall loss around clearcuts in the Oregon Coast Ranges by Cascade Head personnel. Similar studies on a smaller scale were made of this problem at the Wind River and Blue River Experimental Forests.

Isaac cooperated with the Manning Seed Co. in establishing seed zones and development of a certification system for point of origin and climatic requirements of tree seed marketed by the company, which had many foreign customers.

Leo Isaac was awarded a plaque by the Western Forestry and Conservation Association at its annual meeting in Victoria December 10-12, 1952, in recognition of his achievements in Douglas-fir silviculture. Only one similar award had been given previously by the association, and that was awarded to Colonel W. B. Greeley.

Unit area control, a method of pine management developed by the California Station, was under study by the Deschutes Research Center staff to determine possible application in Oregon and Washington pine stands.

Prescribed burning of overstocked pine stands as a thinning method was being studied in cooperation with the Bureau of Indian Affairs on the Colville Indian Reservation in eastern Washington.

Studies of dwarfmistletoe in ponderosa pine were commenced at Pringle Falls in cooperation with the Office of Forest Pathology. Dr. Lou Ruth, of Oregon State College, also cooperated in conducting field examinations.

A series of plots were established on the Rogue River National Forest to study regeneration problems of Shasta red fir *(Abies magnifica* var. *shastensis).* Expansion of Forest Management Research programs provided opportunities to give increasing and overdue attention to associates of ponderosa pine and Douglas-fir in the various mixed-conifer types, particularly those in southwest Oregon and on the upper Cascade slopes.

Tarrant, after putting his Navy blues in mothballs, worked with Washington State College soil technologists in developing a reconnaissance method for classifying Pacific Northwest forest soils. A field trial on the Gifford Pinchot National Forest gave promising results.

The fire research advisory committee was reactivated in 1952 after several dormant years. This was a bad year for escaped slash fires, but it gave the fire researchers the opportunity to observe many slash fires under severe burning conditions. The slash problem was given top priority at the advisory committee meeting.

Tarrant commenced a study of soil reaction, available plant nutrients, and physical composition of slash-burned areas during the year.

It appeared that 1952 might be a turning point in the long struggle to establish an aggressive program of forest influences research at the Station. In August and September, Jerry Dunford returned to the Station on loan from the Rocky Mountain Station to appraise critical watershed problems in Oregon and Washington. He returned by transfer on a permanent basis on November 9, 1952, and commenced developing a complete problem analysis and program of studies. The installations at Blue River provided a starting point for field studies. Donald R. Gedney transferred from the Northeastern Station on July 20 of this year and was assigned temporarily to the Blue River Experimental Forest.

Major efforts of the flood control group were concentrated upon the Columbia Basin Agricultural Program. July 1, 1953, was set as target date for completion of the basinwide reports and completion of separate reports for 4 of the 11 subwatersheds. All or part of the four were in this Station's assigned territory. Flood control activities of the California Station were liquidated in 1952 and their assignments in Oregon, including the Willamette subwatershed, were turned over to this Station.

The flood control unit found time to work on a miscellany of small watershed-related projects during the year.

At the Blue River Forest, Hale supervised installation of modified trapezoidal flume stream gages in the three small experimental watersheds. Servicing the gages was contracted to the U.S. Geological Survey with financial help from Region 6. Hale transferred to the Northeastern Station July 20, 1952.

An erosion study, conducted by Sartz and Hobba on the Portland Forest Park burn of 1951, showed an average loss of 1-1/2 inches of soil depth at 79 study points for a 6-month period with 32 inches of precipitation following the fire. Their study also showed that emergency fire roads were a source of considerable gullying which could have been prevented had adequate cross drainage been incorporated in the road construction.

Bullard and Fittenger of the flood control staff cooperated with the BLM in inspecting results from aerial seeding of mustard *(Brassica nigra)* for soil stabilization on the 1951 Vincent Creek burn in southwestern Oregon.

Participation in the blowdown-bark beetle cooperative project was a major activity of the Forest Insect Laboratory, and the staff spent considerable time in developing techniques to be used for the 1952 survey in addition to the technical services during the actual survey. At the same time, studies of the Douglas-fir bark beetle, commenced in 1946, were continued to learn more about this insect. This work was done in cooperation with foresters and entomologists of the Oregon State Board of Forestry and the Weyerhaeuser Timber Co. It was found that the beetle was in flight as early as March 4 this year, and that a large percentage of the adult beetles that attack trees in early spring reemerge for a second time in late summer—might call these pests two-timers. Other findings were that suppressed trees were often attacked but rarely produced broods, that natural control agents exerted considerable pressure on the beetle population in some areas, and that trees, killed the past 6 years, showed complete deterioration of the sapwood after 3 years and significant deterioration after 4 years, valuable information for salvage plans.

Aerial spraying for spruce budworm continued during the year, covering 665,000 acres, making a total cost of $3 million spent in control of this current epidemic. Studies of natural control factors on sprayed and unsprayed areas in 1952 showed no evidence of major decline of the outbreak from parasitism. Accordingly, plans were made to continue the spraying in 1953.

Grazing management studies commenced on the Starkey Experimental Range after many years of preparation. The plan was revised and submitted to the Washington Office for final approval in 1952. The reason this work was given major attention was the conviction that improvement of about 90 percent of the summer ranges in eastern Oregon and Washington can best be accomplished by improving grazing management practices. It was believed that the Starkey Experimental Range, when in full operation, could be a showcase for good practices.

The Range Management Division cooperated on the prescribed burning studies on the Colville Reservation with the objective of finding effects of this measure of thinning dense young pine forests on range vegetation and the soil. Proper management of ponderosa pine forest rangelands on the east side requires optimum production of wood and forage consistent with the site potential. There were many overstocked ponderosa pine stands in this region, particularly in eastern Washington.

Studies showed that light mulches of sawdust or sheep manure are apparently effective in protecting seedling stands from frost heaving on scab ridges reseeded to grass.

Tentative levels of proper winter use of some important eastern Oregon and Washington shrubs were determined from a study covering 7 years and concluded in 1952. The study indicates that bitterbrush *(Purshia tridentata)* can be utilized 60 to 65 percent on good sites and 50 percent on poorer sites; snowbrush ceanothus *(Ceanothus valutinus),* 35 to 40 percent; and creambush rock spirea *(Holodiscus discolor),* 50 to 60 percent. These data are useful in studies of big game-livestock relationships.

Richard S. Driscoll was added to the staff of the Blue Mountain Research Center June 23 as a range conservationist (research).

Joe Pechanec attended the Sixth International Grassland Congress held at State College of Pennsylvania August 17-13, presenting a paper on “Machinery for Clearing Brushlands.”

Late in the year, Pechanec was selected to replace W. R. Chapline, Chief of Division of Range Research, Washington Office, who was retiring at the end of the year. Joe moved to the top of the Range Research ladder January 4, 1953.

Chief Lyle F. Watts retired on June 30, 1952, and Richard E. McArdle was appointed in his place as Chief of the Forest Service. McArdle had been assistant chief since 1944, 20 years after entering the Forest Service as a junior forester. Interestingly, his entire career until he became an assistant chief had been spent in the Branch of Research.

Change still seemed to be the name of the game in 1953. There were important changes in organization structure and in key personnel. Regardless of this situation, resumption and expansion of work in the post World War II period was producing tangible results as reflected in completion of studies and publication of results. Review and reorientation of programs through internal review and advisory group discussion and consultation was resulting in an investigative program that was keyed to important and urgent problems. The organization was functioning well and jobs vacated by transfer were filled with competent people. However, there were still two important fields of study that needed much more muscle. This year the Region 6 Forest Service Advisory Council held a meeting at the Pringle Falls Experimental Forest. The need for strong programs in forest genetics and watershed management in this region was presented to the council and endorsed by that group.

Undoubtedly, the most important single action of the year occurred on October 13 when Secretary Ezra T. Benson announced plans for reorganizing the Department of Agriculture. The Forest Service was given responsibility for forest insect and forest disease research.

Under a memorandum from Secretary Benson, dated November 2, 1953, and effective January 1, 1954, in this region, programs, personnel, and facilities of the Portland Forest Insect Laboratory, Bureau of Entomology and Plant Quarantine, and the Portland Office of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering, were transferred to the Station, becoming the Divisions of Forest Insect Research and Forest Disease Research, respectively. Resume of the programs and results was included in the Station's Annual Report for 1953. Since these groups had worked closely with the Station over many years, the transfer was made easily. The Forest Insect group and the Station had been housed on the same floor of the U.S. Courthouse for nearly 20 years, so no physical move was necessary. The Forest Disease staff, who were housed in the New Post Office Building, remained there until additional space at the Station headquarters could be obtained.

The departmental reorganization also resulted in the transfer of the Station's work in range reseeding to the Agricultural Research Service, necessitating reorientation of the range research program and resulting in the transfer of Robert S. Rummel to the Southeastern Station October 11, 1953.

The Department had been giving special attention to cooperative and coordinating phases of the research program for the past year or two as an aid in developing a realistic and balanced research program. In 1952, a National Advisory Committee on Forest Research was appointed.[5] This committee functioned within the committee system developed by the Agricultural Research Service.

Dr. David F. Costello transferred from the Rocky Mountain Forest and Range Experiment Station effective February 15, 1953, to replace Pechanec as Chief of Range Management Research.

5 The committee was composed of 11 members representing a diversity of interests and sections of the country. The only professional forester in the group was Dean S. T. Dana. Clarke Heritage, a forest products engineer and a former member of the staff of the Madison Laboratory, currently employed by the Weyerhaeuser Timber Co., represented the Pacific Northwest The first meeting of the group was held December 1-3 in Washington, D.C. Gus P. Backman, secretary of the Salt Lake City Chamber of Commerce, was elected the first chairman.

On April 11, 1953, Arthur W. Greeley was transferred to Juneau as Regional Forester of Region 10, replacing B. Frank Heintzleman, who was appointed by the President as the first Governor of the newly created State of Alaska, holding that position until an election was held.

Leo Isaac attended a forestry congress of European foresters at Stuttgart at the invitation of the West German Government. Douglas-fir seed was being extensively used by European countries, and Isaac's expertise on Douglas-fir regeneration was a feature of the Congress. Following the meetings, Leo visited a number of Western European countries, working with their foresters who were using seed from the Pacific Northwest.

A. C. Knauss was detailed to the Mutual Security Agency to conduct a 17-member group of European wood technologists on a 6-week tour through the glued-wood laminating industry of this country. He went to Paris, France, in February to arrange for the tour. Following this conference, he visited wood industries at a number of points in Germany, Switzerland, Holland, and Sweden.

Often, personnel who keep the wheels of the organization running smoothly are unnoticed in favor of those who attract attention by dramatic research results. In 1953, however, "Mory" Moravets and Dick Wilson received merit awards from Chief McArdle; Mory, for carrying a double load of responsibility on defense projects and the forest survey, and Dick, for his work on the Douglas-fir bark beetle project.

The Blue River Experimental Forest was renamed the H. J. Andrews Experimental Forest in honor of our late Regional Forester. Dedication ceremonies were held at the forest on July 26. Chief Forester Emeritus Lyle F. Watts gave the principal address. Other speakers were Regional Forester Stone, Oregon State Forester George Spaur, Hillman Luedemann, a prominent lumberman, and the Director. Hoss Andrews was Regional Forester here when this 15,000-acre watershed of virgin timber was established in 1948. Mrs. Andrews and her daughter were among the hundred persons who attended this tribute to Hoss Andrews.

By this time, the Douglas-fir subregion was supporting two distinct forest economies, one using old-growth timber as a raw material base and the other using second-growth. Each had separate problems as well as common ones creating complex, and at times contradictory, situations and problems. One that recently became acute was emergency timber salvage programs to control insect epidemics, the Douglas-fir bark beetle in this instance. This action radically interrupted long-range management plans on other land. Such situations illustrate the need for expanding research on the protection phase of forest management, prevention and control of loss from insects, disease, and fire. The Northwest Forest Pest Action Committee[6] in 1953 analyzed and reported on needs for an accelerated program of forest insect and disease research.

In the latter part of this year, the Station commenced the organization of a technical research advisory council.

6 H. J. Andrews was a strong force in organization of the Pest Action Committee, as was Ernest L. Kolbe, another former member of the Station staff.

Preliminary fieldwork on the Timber Resource Review got underway in 1953, involving nearly all divisions of the Station, with the heavy burdens falling upon Forest Management, forest survey, and Forest Utilization staffs. First efforts were devoted to preparation of plans. A critical job was assigned to the Forest Management staff which consisted of development of criteria for rating productivity of recently cutover lands. Meagher and Johnson spent considerable time meeting in the field with public and private foresters to develop and agree upon criteria for field examiners to use in judging productivity of these lands by ownership class. This phase of the TRR field surveys was called Task VIII and, since it was to become a subject of some controversy, it could well be called a Herculean task. Phil Briegleb, the director of the Central Station, worked with Len Barrett and Larry Gross of the Washington Office on a nationwide basis on Task VIII, and Phil and Larry spent some time in the field during June with Region and Station personnel. The forest survey staff made good progress on the timber inventory and growth surveys for the TRR, and with the Forest Utilization staff completed fieldwork in the utilization surveys, analysis of the volume and nature of logging and plant residues in the region during 1952.

At the same time, the forest survey completed the regular reinventory on 4.0 million acres of the forest-land area in eastern Oregon and eastern Washington. Unit costs of operations were reduced over previous years, despite a general rise in costs of services and material, a payoff of the emphasis on techniques research.

The final report on the 1952 blowdown and bark beetle survey was published as a Station multilith in July 1953 under the authorship of A. W. Greeley, K. H. Wright, and R. B. Pope.

Knauss spent 2 weeks at the Madison Laboratory on his way home from the European mission for the Mutual Security Agency. Although wood laminating was introduced into this country from Europe, Knauss found that it had not expanded nearly as rapidly there as it had in this country during the last 20 years. He also found that the Europeans were greatly interested in the success of the U.S. Navy in using laminated stems, keels, and frames in boat construction. In return, he believed that we could profit by their approach to the design of wood members in structural shapes other than rectangular.

Results of the utilization surveys, conducted for the TRR and other work of the Forest Utilization Service, showed that utilization practices in the woods and manufacturing plants continued to improve. A standout was the greater use of mill residues by the paper, pulp, and hardboard industries.

During the year, the Madison Laboratory released a report giving guides for grading Douglas-fir peeler logs by their outward appearance rather than estimating the type of veneer they would produce, the basis currently used by the log scaling and grading bureaus. Working with the laboratory and the industry, the Forest Utilization Service arranged a comparative test at an Oregon plywood plant which resulted in improving log grading practices.

The Division of Forest Management completed organization of the research centers by assigning all field studies in western Washington, including those at Wind River, under the Puget Sound Center early in 1953. This had the effect of putting nearly all studies in second-growth Douglas-fir management under one field unit.

An advisory committee was organized for the Siskiyou-Cascade Research Center, meeting for the first time early in November 1953. C. Weldon Kline, a former member of the Station staff, was elected chairman. He was currently head of the Kline Logging Co. operating in southwestern Oregon. Advisory committees at the other centers continued to meet twice yearly.

Meetings held at the University of Washington on July 14 and in Portland on July 16 were a forum for discussing the need for a full-scale program in forest genetics for Pacific Northwest species. Dr. J. W. Duffield, Forest Genetics Institute, Placerville, California, helped plan a species improvement program for this region. Field trials of the *ponderosa-scopulorum* pine hybrid were commenced in the spring of 1953 at Pringle Falls.

The publication in June of Research Paper 5, “Thinning of Ponderosa Pine,” by E. L. Mowat, summarized findings of a series of 25 thinning plots in the ponderosa pine subregion. Some of these plots dated back to 1927. “Soil Moisture and the Distribution of Lodgepole and Ponderosa Pine,” by R. F. Tarrant, published in August 1953 as Station Research Paper 8, cleared up many common misconceptions regarding the major factors affecting occurrence of the two species in this subregion.

The problem of brush control to improve conifer regeneration was receiving increased attention. Although this problem was particularly acute and complex in the Siskiyou-Cascade area, it was also troublesome elsewhere in the Pacific Northwest. Susceptibility of important brush species to herbicides was tested at the Siskiyou-Cascade and Deschutes Research Centers with use of 2,4-D and 2,4,5-T, the major chemicals available. They were found effective on some species, justifying planning of an expanded program of tests. Prescribed burning and chemicals were tried on salmonberry at Cascade Head and Henderson Creek on the Siuslaw National Forest during 1953.

Early work in seeding and planting, started at Wind River and extended through field tests throughout the region, was producing high-value results. For example, the spacing study in Douglas-fir plantations was showing a striking comparison in spacings varying from 4 to 12 feet. Examinations made 27 years after planting demonstrated that wider spacings accelerate diameter growth and produce more usable wood volume. The wider spacings also produced a taller dominant and codominant stand. It was concluded that pruning will probably be necessary in all spacings to produce clear wood within a 100-year rotation. Consequently, a considerable saving in planting costs could be achieved with the wider spacing. Field studies showed that stored planting stock survives and grows as well as freshly dug stock. One test of Douglas-fir 1-0 stock survived better than 2-0 stock when planted under heavy bracken cover. With the expanding area of cutover and burned-overland in the Douglas-fir region needing artificial regeneration, these studies were extremely useful in planting programs on private lands and National Forests. Tree nurseries were being expanded under the auspices of the Forest Service, the two States, and the Industrial Forestry Association.

Direct seeding studies were also being expanded and concentrated field tests were being made of the use of tetramine-treated Douglas-fir and ponderosa pine seeds in an effort to solve the rodent problem.

Thinning studies in second-growth stands on the cooperative experimental forests and at Wind River and Cascade Head were accumulating evidence that young-growth management of Douglas-fir, Sitka spruce, and western hemlock offers attractive opportunities for industrial operations.

Improved design of staggered settings in clearcutting of old-growth Douglas-fir forests was a continuing objective at the H. J. Andrews Experimental Forest, where National Forest Administration and Research were combining their efforts to make this a working example of systematic conversion from virgin forest to a scientifically managed forest. Windfall around the settings was being studied in detail. Factors affecting regeneration on the clearcut units was another objective of intensive study. Size and shape of the cutover area, ground disturbance, soil temperatures, slash accumulation, and burned ground as compared with unburned ground were specific variables under investigation.

With Tarrant back on the job, the forest soil study program was given new life. W. A. Carmean, currently at the Central States Forest Experiment Station, presented the completed results of the soil-site study of Douglas-fir at the 1953 annual meeting of the Soil Science Society of America. Significant findings were: (1) site quality decreases as elevation increases and with increase in gravel content and compaction of soil layers above the substratum; (2) site quality increases with increase in precipitation; and (3) site quality improves with increase in the product of moisture equivalent and gravel content of soil layers above the substratum. Equations expressing these relationships were prepared for the five major soil groups occurring in southwestern Washington where the field studies were made. From these equations, site index tables could be constructed for estimating growth capacity of deforested or recently restocked lands.

Soil questions were also an important part of the current fire studies program. A major long-term study was started 15 years earlier to determine the influence of slash fires on soil properties. Information on change in soil reaction and trend of pH following slash burning was developed in 1953 for three major soil types. It showed that: (1) change in pH increases with severity of burning; (2) first year after burning, pH commences return toward normal, reaching normal in 4 years; and (3) unburned soils within clearcut area did not differ noticeably in pH from soils in adjacent timber. From these studies it was concluded that soil reactions would be minimized if slash fire moves rapidly through light fuel when duff and surface soil are moist.

Morris spent a month in the Washington Office compiling a new edition of the "Glossary of Terms Used in Fire Control."

A critical look at methods used in the appraisal of cloud seeding was included in the fire weather studies. Fire weather in 1953 was below normal severity, a welcome respite from the previous two seasons which set records for severity.

Johnson's return from Washington, D.C., permitted a start on some much needed work in forest measurements. In addition to such studies and the TRR project, Johnson was on call by other staff members and the Regional Office Division of Timber Management for advice and assistance on problems of experimental design and statistical analysis. He expedited the assembly and processing of the pick of the existing total height volume tables for the Douglas-fir subregion. They were issued under the heading "Volume Tables For Permanent Sample Plots As Recommended By The Puget Sound Research Center Advisory Committee For Use In Western Washington."

Johnson also commenced the assembly and classification of 126 volume tables from the forest mensuration files which covered 17 Pacific Northwest tree species.

Forest influences research was still largely in the developmental stage in 1953. Maintenance of the studies underway on the Andrews Experimental Forest was the principal going project. Attention was given problems developing on the dedicated municipal watersheds which were serving over 100 communities in Oregon and Washington. Nearly all of these watersheds contained valuable stands of timber. In a number of instances, these stands were overmature and were stagnating and pressure to cut was mounting in view of the economic loss and the prospect of greater potential loss. For example, a recent bark beetle attack on the 5,000-acre Corvallis city watershed raised the problem of removing infested timber as a measure to control the insect and to abate a prospective fire hazard. This offered an opportunity for cooperative studies with the City of Corvallis, Oregon State College, and National Forest Administration in evaluating effects of salvage logging and attendant road construction on soil structure and stream sedimentation.

The Division of Flood Control Surveys was renamed the Division of Flood Prevention Surveys, and during the first half of 1953 completed its assignments on the Columbia Basin Agricultural Program and preparation of the sub-watershed reports.

Baudendistel and Bullard completed editing of the Columbia Basin summary report with the Soil Conservation Service.

The division was transferred to the Division of Recreation and Lands in the Regional Office on July 1. Later in the year, Baudendistel returned to the Station to fill the vacancy left by Greeley's transfer to Region 10. Twerdal transferred to the forest survey at the Station, and Fittinger, Bullard, Hobba, and Cable remained with Region 6. Sartz transferred to the Washington Office in November 1953.

All records concerning the installation at Lookout Creek and other data pertinent to the continuing forest influences program at the Station were turned over to Dunford.

The transfer of the forest insect and forest disease groups was made effective December 20, 1953, and the Divisions of Forest Insect Research and Forest Disease Research were official members of the Station before the close of 1953—before Christmas for that matter, a cause for celebration and strengthening of the Station generally.

Upon transfer, the Forest Insect Division staff consisted of Robert W. Furniss, division chief; John M. Whiteside, Walter J. Buckhorn, Wm. K. Coulter, Kenneth H. Wright, and Wm. F. McCambridge, entomologists; John F. Wear, air pilot and research forester; and Wilma M. Taylor, clerk-stenographer. The Forest Disease Division staff consisted of Dr. Jesse L. Bedwell, Dr. Thomas W. Childs, George N. Harvey, and Dr. Ernest Wright, pathologists, and Zella A. Manwaren, clerk-stenographer.

The activities of the Division of Forest Insect Research consisted of three major lines of work: research, forest insect surveys, and technical supervision of forest insect control projects. The principal forest insects under study at this time were the spruce budworm, the Douglas-fir bark beetle, silver fir beetles *(Pseudohylesinus)* and the western pine beetle. For several years, epidemic outbreaks of the spruce budworm and the Douglas-fir bark beetle had been underway. Annual air and ground surveys had monitored the course of these outbreaks and control measures were being taken. The silver fir beetles had killed this species extensively in the Washington Cascades during the past 5 years. However, the insect survey showed that in 1953 the infestation covered about 600,000 acres, doubling the previous year's acreage. Studies of the nature of the damage were intensified this year through help of private forest-land cooperators. Underlying causes of this outbreak had not been determined and no satisfactory control measures had been developed at this time.

After a decade of normal activity, the western pine beetle became epidemic in this region a few years before. Steadily increasing, it covered 1 million acres by 1953, including some selectively cut stands. A salvage control project was underway in 1953 on the Deschutes National Forest. Elsewhere sanitation salvage cutting and regular harvest cuttings were being used as control.

A host of other forest insects were under study in a lesser way.

An important and promising development in 1953 was a comprehensive analysis of forest insect research needs made by the Pacific Northwest Pest Action Committee. The Forest Insect Division acted as advisor to the committee. The report recommended strengthening the present research agencies and urged additional organizations to join in the current cooperative program.

The Forest Disease staff had many study projects underway and most of these were being done in direct cooperation with the Station and National Forest Administration. Integration of their program into the Station program was easily accomplished. However, extra efficiency of operation was made possible by the integrated status.

The list of projects included three principal nursery and plantation studies: (1) *Fusarium* root rot; (2) storage problems arising from refrigeration; and (3) mycorrhizal studies. Other going studies included needleblight on ponderosa pine, ponderosa pine mistletoe, blister rust, decay of windthrown and beetle-killed timber, root rots of Douglas-fir and Port-Orford-cedar, and decay and stains of forest products.

The nursery and plantation studies were conducted at the Forest Service nurseries at Bend and Wind River and in the field on several National Forests, notably the Deschutes. Field tests conducted in cooperation with the Division of Forest Management Research had indicated that survival of natural Douglas-fir seedlings might be related to occurrence of mycorrhizae.

A principal study related to blister rust was the susceptibility tests of five-needled hybrid pines developed by the Institute of Forest Genetics at Placerville, California, in search for rust resistant hybrids. These were planted in test plots on the Mount Hood National Forest near Rhododendron.

A killing root rot *(Phytophthera lateralis)* of Port-Orford-cedar had been present in the western part of the region on planted stock for many years, but until recently was not found within the natural range of the species in southwestern Oregon. Now it had been identified in Coos County; a threat to native stands of this valuable species.

Rate of decay in windthrown Douglas-fir, Sitka spruce, western hemlock, and Pacific silver fir, based upon studies in four localities, were reported in a departmental publication. Its title was "Decay of Windthrown Timber in Western Washington and Northwestern Oregon," U.S.D.A. Forest Pathology Special Release 40, by T. W. Childs and J. W. Clark, Sept. 1953.

Studies in the category of decays and stains of forest products included: (1) on-the-job treating tests, usually longtime projects, (2) penetrability tests, (3) field study of fungi causing decay of treated wood, (4) decay of pulp chips, (5) decay of wooden members of aircraft carriers and small boats, and (6) building decay studies. All of these studies were cooperative in nature. Cooperators included the Madison Laboratory, the Oregon State Forest Products Laboratory, the lumber trade association, and, in the case of item 5, the cooperator was the Bureau of Ships, U.S. Navy.

The work of the Division of Range Research was interrupted during 1953 by the loss of reseeding research, the transfer of Rummel, and the detail of Holscher to the FAO in Rome, Italy, in November. Holscher served as a consultant in planning for a technical meeting on forest grazing to be held in Rome in the spring of 1954. Office analysis of the summer's field data was seriously delayed by these events.

A major objective of the division was completing the physical facilities for the Starkey grazing management study. Addition of 3,000 acres of National Forest land to Starkey allowed use of cattle from one permitted on all the experimental pastures. Cooperation of the stockmen furnishing cattle and their range rider for Starkey expedited progress in grazing management activities. Conclusions from fieldwork and analysis of 1952 data demonstrated that proper salting, adequate water development and efficient range riding produced good distribution of cattle and uniform forage use.

The water development program on Starkey during 1952 demonstrated that on the Blue Mountain summer ranges, water is where you develop it, not where you find it. At the beginning of the program on the Starkey in 1949, there were nine trough developments on the 24,000-acre range and 15 other springs considered as potential developments. By 1953, there were 45 water developments, doubling the number considered possible 4 years previously. These were done comparatively cheaply; 15 waterholes were constructed at an average cost of $17 each.

During the year, division personnel participated in the work of the interregional committee dealing with the inter-state deer herd which migrates between southeastern Oregon and northeastern California.

Loss of the range reseeding work caused considerable reorientation of the division's program and planning for the next year's fieldwork. During 1953, reseeding information collected in earlier years was summarized in manuscript form for submission, after review and editing, as a U.S.D.A. circular early in 1954.

In June 1954, the Station headquarters in Portland were moved to 729 N.E. Oregon St. in a two-story building, and tourist center in that general area. The Regional Office was also moving to the same building, bringing many advantages in external and internal relations. It made possible the location of the Division of Forest Disease Research with the other divisions and provided laboratory and storage space in the basement level.

During the year, the Station completed its assignments on the field phases of the Timber Resource Review and completed reports on Tasks V, VI, and VII were sent to the Washington Office before the year's end.

Early in 1954, after a lapse of a number of years, a Station advisory committee, with a complete new roster of members, was organized following departmental guide lines. The first meeting was held February 25 and 26, 1954, at which time officers were selected and plans and procedures outlined.[7]

The work of the Station was aided in many respects by the addition of Elwyn F. Peffer, a forester-editor, to the staff by transfer from Region 6. In 1948, Clyde M. Walker was employed by the Station on a "share-the-expense" basis with the California Station. Walker, after a brief period in Portland, was headquartered in Berkeley. After a few years, it became evident that there was more work than one person could handle, leading to employment of Peffer at this Station.

Highlights in the record for Forest Management Research during 1954 were the reactivation of the Willamette Research Center with headquarters in Corvallis and the start of a formalized forest genetics research program. Both of these actions were made possible through the cooperation of the School of Forestry, Oregon State College.

Actually, forest genetics research at the Station dates back to 1912, when the Wind River Arboretum was established in the search for improved forest trees. This was followed by initiation of a Douglas-fir provenance study in 1913 and a study of regional races of ponderosa pine in 1926. The assignment of Roy Silen to a full-time position in forest genetics work in 1954 gave full recognition to this important field of research. Headquarters were established at Corvallis, where office, laboratory, greenhouse, and arboretum facilities were made available through the college. Silen also started a graduate program in plant genetics, leading to a doctorate.

A preliminary program was prepared and distributed to interested professional foresters. It had three objectives: (1) production of more and better tree seed for early use through identification and improvement of above-average natural seed-producing stands, (2) production of genetically superior seed in seed orchards of scions from elite trees, and (3) species improvement by developing genetically superior trees through selection, controlled pollination, hybridization, and progeny testing.

The division's program in seeding received a temporary setback when tetramine, a promising rodenticide, became unavailable late in the year. The Denver Laboratory of the Fish and Wildlife Service had two other promising chemicals which were ready for field testing in 1955.

Results of 1954 planting studies centered around two species, western hemlock and Port-Orford-cedar. Western hemlock 2-0 stock, furnished by the British Columbia Forest Service, showed exceptional first-year survival on a bracken- and brush-covered area on the Hemlock Experimental Forest near Grays Harbor. In the fog belt, it was expected to outgrow Douglas-fir and be less susceptible than Douglas-fir to animal damage. Review of results from 26 plantations of Port Orford cedar in the coastal area extending from northern California to Puget Sound shows that survival of this species is generally satisfactory, but growth is restricted by animal damage and by competition from other vegetation, including volunteer trees of indigenous species.

7 The meeting was held at the Masonic Temple in Portland; the Station had lost its conference room in the U.S. Courthouse during World War II, being outranked by the military and, in the postwar period, by the FBI who needed more space. The following members or alternates attended the first meeting: N. E. Bjorklund, Dr. Mark T. Buchanan, Donald E. Colwell, Geo. L Drake, Dean Paul M. Dunn, R. C. Gerhart, W. E. Griffee, Dr. A. L. Hafenrichter, E. F. Heacox, Elmer Lofgren, Dean Gordon D. Marckworth, David T. Mason, Leon R. Nadeau, Joseph C. Oliver, Al Petzold, Dean F. E. Price, W. Carl Rasmussen, C. W. Richen, Dr. O. Harry Schrader, Jr., J. Herbert Stone, R. T. Titus, T. M. Tyrrell, L T. Webster, and John B. Woods, Jr. E. F. Heacox, Weyerhaeuser Timber Co., was elected chairman, and C. W. Richen, Crown Zellerbach Corp., was named vice chairman. A second meeting was held in November.

The Station's revived program of forest measurements was producing a number of important contributions and more were in the offing. Outstanding in 1954 was the development of a method for estimating normal mortality for fully stocked stands of Douglas-fir. Another promising contribution was the Station's issuance late in December of "Standard Computations For Permanent Sample Plots," by G. R. Staebler. This was a manual and was developed and sponsored by a subcommittee of the Station's Puget Sound Research Center Advisory Committee, an active and competent group of cooperators. Use of procedures in the manual would permit pooling data and facilitate comparing data on growth plots collected by various agencies and companies in western Washington.

For the second successive year, fire weather in western Washington and Oregon was far below normal severity. However, development of improved methods for predicting fire weather and burning conditions was still a problem demanding great attention by all fire protection agencies in the Pacific Northwest. The Station was still seeking leads for development of new methods for predicting windspeed and fuel moisture that would be sufficiently accurate for day-to-day use in fire control planning.

Progressive strip cutting in spruce-hemlock at Cascade Head was tried for the first time in 1954 to compare this method of cutting with staggered settings.

Detailed logging costs had been collected regularly as a part of the Station's pilot plant-harvesting and stand-improvement experiments. However, not since the Brandstrom studies of more than a decade and a half earlier was an intensive analytical study of logging costs per se made until 1953, when an intensive time study of production and costs in high-lead yarding was started at Cascade Head in a 100-year-old spruce, hemlock, and Douglas-fir stand. This study was made in cooperation with Oregon State's School of Forestry and was done under leadership of Magnus Tennas, a Norwegian research forester in this country on a Smith-Mundt fellowship. Purpose of the study was to determine influence on costs and production of certain basic factors; yarding distance, volume per turn, slope, and timber volume per acre. Haul-in distance and volume per turn were found to be the most important factors, respectively.

A comparison of logging costs for commercial thinning and clearcutting, made at Wind River, indicated that felling, bucking, yarding, and loading costs per thousand board feet were only slightly higher for the thinning operation than for the clearcutting.

Reduction of windfall on exposed timber edges following clearcutting was a major objective in management studies of the old-growth Douglas-fir type. This problem was intensively studied on the H. J. Andrews Experimental Forest. Analysis of wind patterns, soil and stand conditions, topography, species rooting habits, and location of cutting boundaries showed that effects of these factors were far more important than size of the clearcut. It was concluded that consideration of the relationships of such factors suggest a number of ways in which windfall damage can be reduced through layout and design of cutting units.

Increased construction of access roads on both National Forest and private land was found to provide profitable opportunities for salvaging mortality in stands opened up but not scheduled for early clearcutting. Analysis of a 6-year record of permanent sample plots on the Wind River Natural Area showed that mortality losses in a 350-year-old stand averaged about 760 board feet annually, about 60 percent Douglas-fir and the remainder in associated species. It was estimated that about 600 board feet per acre could be salvaged annually, thus substantially increasing yields from reserve settings in such types. Tests of salvage methods and equipment were started on the H. J. Andrews Forest in 1954.

Official approval early in 1954 of the Round Mountain Experimental Management Block on the Deschutes National Forest adjoining the Pringle Falls Experimental Forest made possible pilot plant tests of management practices for ponderosa pine and lodgepole pine. This unit was planned for joint operation by National Forest Administration and the Station as a testing ground for applying research findings to determine practical intensities of developing forest practices.

Interest was growing in management of lodgepole pine stands, and in the fall of 1954 a special study was made in central Oregon of seed retention characteristics of lodgepole pine cones. It was known that in many parts of its range this species retains viable seed in closed persistent cones for many years. This observation had been questioned in central Oregon. It was found that in this general area, although cones hung on for 25 years, only the current year's cones contained viable seed, indicating that extensive clearcutting of lodgepole pine should be avoided in central Oregon if it is desired to perpetuate this species.

The Timber Resource Review gave special emphasis to destructive agents such as fire, insects, disease, weather, and animals as a major deterrent to present and future productivity of forest land. It was long known that mortality loss alone did not fully reflect lasting damage from such causative agents. This periodic review developed and presented a new term, "growth impact," as a concept for estimating total losses. It attempted to quantify losses in timber volume but no attempt was made to evaluate losses in quality of timber products resulting from action of these agents. For the country as a whole, it was found that "insects cause the greatest mortality" but "diseases cause the greatest growth impact." During 1953 and 1954, the Forest Disease and Forest Insect staffs developed and contributed information on these losses for this region. A great deal of new ground had to be plowed in meeting these assignments for the TRR. Release of information of this type gave a much greater appreciation and understanding of the importance of forest disease and insect research. Locally, the appointment of a forest disease research subcommittee of the Northwest Pest Action Committee greatly assisted in stimulating and coordinating research in this field.

In 1954, a systematic survey of the Port-Orford-cedar root rot was made in cooperation with the Oregon State Forester, the State Department of Agriculture, and the Oregon State Forest Experiment Station. However, major emphasis was continued on the survey of *Poria* root rot of Douglas-fir.

Heavy losses during harvesting and shipping of Christmas trees in the 1953 season in the Puget Sound area were followed by moderate losses in 1954, evidently caused by a needlecast fungus. This caused considerable concern on the part of Christmas tree operators, a thriving forest industry in the region open to the small enterpriser. Strong interest developed in support of a sustained program of problems common to the harvesting and shipping of Christmas trees in the Pacific Northwest.

Integration of the Forest Insect Research unit into the Station program did not result in any material change in activities. Increased allotment of funds, however, made it possible to add Robert B. Pope to the staff for survey techniques study by transfer from the forest survey. Another man, Valentine M. Carolin, was added to the staff for biological control studies by transfer from the Northeastern Station.

For the sixth consecutive year, the principal control activity was aerial spraying against the spruce budworm. Results from study check plots showed that spraying properly applied is effective up to 5 years after treatment. It was also found that parasitism of overwintering budworm larvae on many of the sprayed areas was equal to or greater than average parasitism on unsprayed areas, leading to the conclusion that spraying had no harmful effect on major parasites of the budworm.

The aggressive epidemic of the Douglas-fir bark beetle declined greatly in 1954 over most of the infested areas. However, it continued high in parts of southwestern Oregon. It was also attacking stands in the Blue Mountains of eastern Oregon, which had been repeatedly defoliated by the budworm.

A new insect enemy of the Pacific silver fir in western Washington turned up in 1954. The area of this species infested by the silver fir beetle increased noticeably in 1954 and an insect, identified as balsam woolly aphid *(Chermes piceae),* was found infesting this species on 130,000 acres alone and in combination with the silver fir beetle on an additional 146,000 acres in southwestern Washington.

During 1954, studies in insect survey techniques developed and extended aerial photographic methodology. Considerable work was done on color photography.

Watershed Management[8] Research expanded in a small way by installation of a study to relate soil erosion to intensive cattle use at the Starkey Experimental Range on the experimental pastures. Progress was also made in a cooperative undertaking with the City of Tacoma and U.S. Geological Survey to study the effect of logging upon water yield and silt pollution on that city's municipal watershed on Green River watershed in the Snoqualmie National Forest. Efforts in 1954 were limited to locating sets of paired small watersheds to study these objectives.

Watershed research still suffered from pecuniary anemia and palliatives were sought in developing cooperative projects. At this time, preliminary discussions were underway with Portland city officials for a similar study on the Bull Run watershed on the Mount Hood National Forest.

Runoff records of various streams in the region, analyzed by Dunford, showed that soil formations can result in widely different stream behavior. Pumice soils common to the high Cascade Range showed unusual efficiency in regulating streamflow.

Since the outbreak of World War II, the work of the Division of Forest Economics dealt almost entirely with the forest survey and closely allied projects or with special surveys made as a part of the Nation's defense program or for the periodic appraisals of the Nation's timber resources. In July 1954, allotment of a modest sum for study of the economic problems arising from management and utilization of the multiresources of the region's forests financed the addition of T. A. McClay to the staff late in the calendar year by transfer from the Southeastern Station. Plans were made for start of an actual study program the following year. The completion of a comprehensive problem analysis was given first priority so that specific projects could be assigned priorities.

Approximately 3-1/2 million acres were covered in the reinventory program despite the diversion of the survey staff to TRR jobs. This acreage figure was about 1 million acres short of the estimated rate needed to keep abreast of demand for reasonably current reliable information on the Pacific Northwest forest resources and to answer the increasing number of calls for special compilations of survey data for various purposes and agencies.

The utilization of sawmill and plywood plant residues as a source of raw material supply for the region's pulpmills had increased steadily in the past few years. For the first time, a large company constructed a pulpmill without the usual "wood room," depending entirely upon chips from outside sources. This was the Western Kraft Co. mill at Albany, Oregon. For several years prior to this event, the Division of Forest Utilization and the forest survey of the Division of Forest Economics had furnished information on availability of raw materials and other site factors to pulp companies, industrial consultants, and individuals considering locations for construction of pulpmills of this type. The Madison Laboratory was also a source of technical information. Director Hall and Dr. E. J. Locke of the Laboratory were particularly valuable in advising prospective locators, owing to their familiarity with conditions in this region and their understanding of pulping technology.

8 A general change in nomenclature developed about this time with "Watershed Management" taking precedence over "Forest Influences" as the preferred term.

The organizer and president of the Western Kraft Co., Ira Keller, was one of those consulting the Station regarding such data. At that time, he was vice president of the Container Corp., a concern long known nationally but not established in this region.

Following construction of this pioneer plant, several other companies announced plans to build similar plants. Another new industry using mill residues was coreboard manufacture. One plant started operations here in 1954, gluing small particles of wood together to form large sheets. The product was used principally in the furniture industry. In addition to the plant in operation, three more were under construction during the year.

The efforts of the Forest Utilization staff and the Madison Laboratory in promoting greater use of red alder began to produce results in this period. Several large pulpmills made substantial additions to their plants at this time to facilitate use of red alder, installing specially designed log barkers.

The red alder log and lumber grading study was completed and a report was published by the Oregon Forest Products Laboratory.[9] The study was a cooperative project of the Corvallis Laboratory, the Madison Laboratory, and the Station.

The Forest Utilization staff had a major part in the installation of the first large-size Wyssen Skyline Crane in the United States. It started operations on the Chelan National Forest[10] on a sale of 7.2 million board feet with a four-man Swiss crew under supervision of Mr. Jacob Wyssen, the manufacturer of this equipment. Considerable negotiating with State of Washington agencies, the U.S. Immigration Service, and labor union officials preceded this operation with the Station acting as expeditor and sponsor. The Swiss crew had to have workers' permits and there were some problems and objections raised about the use of foreign labor and safety features of the equipment. The operation was watched with considerable interest by many people.

With the physical facilities practically complete, the Starkey grazing management project entered the investigative phase; calibration studies were completed on one block of six experimental pastures and study of the rates of grazing and of deferred-rotation grazing started. The Starkey project was attracting a large number of visitors and the Range Research staff conducted 11 show-me trips to the area during 1954. Interest of the Committee on Economics of Range Resources, Western Agricultural Economics Research Council, in furthering this phase of research led to a proposed cooperative project. Negotiations were started with the Department of Economics, Oregon State College, to formulate a plan for a joint study of range economics in connection with cattle studies on the Starkey.

The results of the Station's range reseeding work, now terminated, were summarized in report form for publication as a U.S.D.A. Farmers Bulletin.

Garrison, in company with a representative of the Agricultural Research Service, made a field examination of the range reseeding study areas during the year. Since the ARS had a greater interest in reseeding studies closer to the farm, it did not plan to continue the studies the Station had underway at the time of the transfer. Arrangements were made with National Forest Administration to maintain and protect the Swauk grass nursery to protect future study values.

9 "Red Alder Log and Lumber Grading," Oct. 1954, by J. R. Pfeiffer, Oregon Forest Products Laboratory, and A. C. Wollen, Forest Products Laboratory, U.S. Forest Service.

10 Soon after, the name of the Chelan National Forest was changed to the Okanogan National Forest following boundary changes of several adjoining forests.

Studies of the nature of competition or compatibility between big game and livestock on the region's east-side ranges demonstrated the importance of information of the impact of game animals on the range. Studies on permanent plots in 12 experimental pastures showed that use by deer and elk varied from 11 to 33 percent. This points out that regardless of variations in game animal numbers from area to area or from year to year, they must be considered one of the major factors in range management.

On the occasion of the 30th anniversary of the Station's establishment and of his initial appointment to the regular rolls of the Forest Service, Chief McArdle noted the event by the following letter addressed to the Station through the Director:

> "I reported for work at Portland in late June of 1924. The first person I saw was June Wertz, who at that time was secretary for Regional Forester George Cecil. This is written in 1954, but I can remember as if it were only yesterday her bright, alert, courteous smile as I came in the door. Maybe she was only smiling at me as she later did at some of my peculiar antics, but I didn't think so at the time. I was the new boy, and she made me feel at home even before she knew anything about me. Sometimes I think we forget how much first impressions can mean to a new person reporting for work or to a visitor to our offices. June Wertz was a good representative of the Service for a good first impression.
>
> Thornton Munger had been chosen Director of the new station, but until July 1 he had no money to operate. So until July 1 I put in the first of what in years to follow I learned was "contributed" time. I was given a table in a room with Julius Kummel and handed a box full of Douglas-fir yield study field notes to review. These were the notes taken by Munger and Ed Hanzlik in 1909 and 1911. Looking back 30 years I suspect that these notes meant very little to me at that time. About all I could figure out was that 10 plots were laid out here and 17 plots laid out somewhere else, and on these plots number and diameters of trees were recorded. Many of the terms used such as "first bench above the river" were unfamiliar to me.
>
> Edwin Mowat reported for work July 2 and John McGinn on July 3. These were to be field assistants on the Douglas-fir yield study I was to work on for the next two years.
>
> Thornton Munger, as I was later to learn more fully, was not a man to waste time. On July 3, he took me to Yacolt, Washington, to select a place to begin work on the yield study, and on July 4 (which heretofore I had thought was a holiday, but that was before I began working for the Forest Service) he moved me and my crew in his personal car to Yacolt. We spent that afternoon measuring sample plots.
>
> From then until November 21 we kept (or Munger kept) our noses to the grindstone and we traveled up and down western Oregon and Washington. We finished the season at Cottage Grove. Mowat left the crew in September, and Bob Marshall, who had been working at Wind River with Leo Isaac, took Mowat's place for a few weeks until Leonard Barrett arrived in October.
>
> In early August, while we were at St. Helens, Oregon, Munger brought us a car, a Dodge touring with the front seat hinged so that we could sleep in the car and save hotel bills. (I spent much of 1925 doing just that and still have a crook in my spine.) This car was No. 21 on the FS license plate, and I believe was the first of the Station's many cars and trucks. No. 88, a Ford pickup, was the second; Westveld took this to eastern Oregon.

When we returned to Portland in November the office was in the Lewis Building, where we had (I think) five small rooms. Barrett stayed on and we spent the winter trying to work up a preliminary yield table. The following year (1925) Barrett went to Alaska and I continued field work on the Douglas-fir yield study with two crews.

In 1924 Munger visited our field crew regularly to check on the progress of the work and the way we were going at the job. I was impressed then as I was to be even more thoroughly impressed in the years to come with his meticulous attention to accuracy, his ability to bore thoroughly into a subject, and his knowledge of the region and its forests. He would not accept anything less than a good job, and to meet his high standards we were obliged constantly to aim at a high mark. If today I attempt to set high standards of accomplishment, Thornton Munger is more responsible than any other person for building in me these ideals for doing a competent job. In personal characteristics, in such things as personal integrity and the like, Munger made no compromise with anything less than 100 percent. I hope some of this strength of character rubbed off on me, too. In those first days of the Station Munger was all over the lot, moving fast to get projects underway, to get the physical plant established, to organize and reorganize, getting the Station recognized as a new force in Pacific Coast forestry. Looking back I still don't see how he managed to do so much with so little money, so few people to work with."

/s/ R. E. McArdle
RICHARD E. McARDLE
May 10, 1954

In 1955, the 50th anniversary of establishment of the Forest Service by transfer of the "forest reserves" from the Department of Interior to the Department of Agriculture, preliminary findings of the Timber Resource Review were released. Although the final report, "Timber Resources For America's Future," was not published until 1958, the preliminary releases showed the magnitude of the changes that had taken place during that half century and emphasized the important place the Pacific Northwest forests had in this country's present and future forest economy.

It was singularly appropriate that in 1955, "Forestry and Related Research in North America," by Frank H. Kaufert and William H. Cummings, was published by the Society of American Foresters. This study, made under the supervision of a five-man steering committee, selected jointly by the Society of American Foresters Council and the Division of Biology and Agriculture of the National Research Council, was funded by the Rockefeller Foundation. It is interesting to note that both authors had some connection with this Station. A quarter of a century before, the senior author was employed as a field assistant at Wind River between undergraduate and graduate work at the University of Minnesota. Bill Cummings, a few years after 1955, came to this region as head of the Weyerhaeuser Timber Co. forest management research staff. He worked closely with the Station and was a member of the Station's advisory committee.

This publication points out that this is a “research conscious nation” and that “although the forestry and related research program is but a small part of the national research effort, it attains major importance through affecting every citizen, directly or indirectly.” Based upon extensive record studies, interviews (written and oral), and cooperation of many agencies and individuals, the authors made a comprehensive review and analysis of past and present research in these fields. This was followed by “recommendation and goals, the next quarter century” concluding that “more research is needed.” This recommendation was documented by “recommended expenditures” by dollar amounts and for major fields of study for the year 1978.[11] It emphasized the urgent need for more basic or fundamental research and high-quality, well-trained personnel. The authors pointed out that “The problem of providing for more basic research is closely related to that of graduate training.”

The Station had long recognized these dual needs and had encouraged graduate training as a Station policy for over a quarter of a century, commencing when H. E. McArdle as a junior forester took educational leave to complete a doctorate program. Lack of funds for construction of laboratory facilities necessary for basic research was one obstacle to greater emphasis on such studies. Furthermore, appropriated funds were directed through legislative record towards early solution of problems through applied or operational research, leaving little fiscal flexibility for long-term basic research. In recent years, the Station was able to encourage personnel taking institutional graduate training in several ways, including assignment of candidates to research centers located at or near forest schools.

It was chance that the 50th anniversary of the Douglas-fir plywood industry also occurred in 1955. However, it was not through chance but through research and technological progress that this industry grew in half a century from an exceedingly modest beginning to what was labeled a “billion dollar industry.” This industry became a major factor in a diversified and integrated timber industry leading to improved utilization and better management practices of the Pacific Northwest forest resource.

Strong markets for manufactured timber products resulted in rising log and stumpage prices and improved utilization in the woods and increased use of plant residues. Recent surveys showed that within about a decade, volumes of logging residues were nearly cut in half.

The Forest Utilization Service shaped their program to match these developments. Encouragement and study of the Wyssen Skyline Crane operation on the Chelan National Forest was an example. Saving in road costs and minimizing soil disturbance by some form of aerial transportation of logs permits utilization of areas previously considered inoperable owing to excessive costs and site hazards. Beginning operations of the Wyssen system, covering 2 million board feet, showed that costs were comparable to tractor logging. More conclusive judgments would be made when the remaining 5 million board feet were logged.

The present reinventory cycle of the Douglas-fir region was started by the forest survey in 1946, following the close of World War II. At the close of 1955, 10 years later, some 31 million acres had been covered. It had been planned to complete the cycle in from 10 to 12 years, with the premise that in counties where no great changes had taken place the period between inventories could be lengthened and vice versa. However, it was evident that means should be found for making greater progress. County statistical reports and new detailed 1-inch-to-the-mile forest type maps were still being issued as soon as possible after completion of the fieldwork, usually in less than a year. Continued heavy demands for this information and service jobs of various kinds justified continuance of this practice despite the inroads upon survey field progress.

11 In retrospect, the 1978 dollar amounts are totally inadequate, owing to shrinkage in the value of the dollar.

Techniques research was being continued in search of cost-saving methods. From October 20 to 25, the Forest Economics Division was host to a forest survey meeting in Portland. Present were representatives of the Washington Office, the California, Intermountain,[12] and Pacific Northwest Stations, and the Alaska Forest Research Center. The purpose of the meeting was to discuss current techniques and specifications and procedures currently being used in the Western States, including Alaska, and to plan studies for improving techniques and for developing uniformity of standards and specifications. Working groups were formed to accomplish these objectives.

A study of the economic aspects of establishing stands of Douglas-fir following cutting was commenced. A comparative analysis of cost ratios of establishing ponderosa pine, sugar pine, or Douglas-fir in southwest Oregon was made during the year by McClay.

Projects of the Division of Forest Disease Research are of longtime nature, observations made each year adding to the fund of knowledge. Special situations arise from time to time demanding shorttime studies. Studies of rates of deterioration of beetle-killed Douglas-fir and Pacific silver fir progressed rapidly as suitable trees became available. Estimates of decay cull in Pacific silver fir were compared with pulp yields and with log scaling bureau standards. A joint publication was submitted to the Journal of Forestry.

A number of diseases not of project status cropped up from time to time and were reported to the division for diagnosis and advice. For example, considerable top-dying of western hemlock and Douglas-fir was occurring in various parts of the Douglas-fir subregion. This was found to develop from a complexity of causes; physiological, climatic, insects, and disease. The sudden November 1954 freeze was responsible for much of the top-dying in Douglas-fir.

A number of chemical sprays had been tried as a means of controlling ponderosa pine dwarfmistletoe. Use of various strengths of sprays had disclosed that many 2,4-D and 2,4,5-T derivatives were too harmful for the host for general application. A few sprays gave promise to be relatively harmless to the pine and quite effective against the aerial parts of the mistletoe. More research was needed for getting dilute solutions into the sap stream to kill the mistletoe haustoria.

The spruce budworm control project appeared to be nearing conclusion with the spraying of an additional 600,000 acres in 1955. The 7-year score was 3.8 million acres sprayed at a cost of $4 million, or an average cost of $1.05 per acre. Reports from all sources showed that the program averted much greater losses.

Studies of improving insect survey methods were bringing positive results. Plots for evaluating Douglas-fir beetle damage were re-photographed in color and ground-checked for the third year. Analysis of the 1953 phase of the study showed that photographic interpretation of mortality, with some field checks, was cheaper than a ground survey of comparable accuracy. This proved true of both panchromatic and color film, with the latter giving the greater saving. These results were presented at the annual meeting of the Society of American Foresters held in Portland in the fall of 1954 and published in the Proceedings in 1955.

Prospects for natural control of the spruce budworm on unsprayed areas appeared promising as surveys showed parasitism significantly higher than for previous years.

12 The Northern Rocky Mountain Station was merged with the Intermountain Station about January 1, 1954. During that time, Stephen N. Wyckoff retired as Director of the California Forest Experiment Station and was succeeded by Dr. George M. Jemison, who was the last director of the Northern Rocky Mountain Station.

The outbreak of silver fir beetles dropped sharply in 1955. Intensive research on the biology and ecology of these beetles was started in 1955 with the assignment of Carolin full time to this project. Exploratory studies of the balsam woolly aphid to determine its distribution, habits, and importance were continued.

Highlight of the year in watershed management investigations was the elevation of this important work to full divisional status and the promotion of Dunford to division chief. It was a long time coming and financing from regular funds was minimal, but with greater public appreciation of the role of forests in watershed management and the vital dependency of the total Pacific Northwest economy upon its water resource, prospects for support of an adequate research program were encouraging.

In January 1955, an appraisal of Oregon's water supplies was contained in a report by the Governor's Water Resources Committee to the Oregon legislative assembly. Water was the subject of the 1955 Yearbook of Agriculture, which included two articles by Station authors; one by E. G. Dunford in joint authorship with Sidney Weitzman of the Northeastern Station, and the other by G. L. Hayes in joint authorship with J. H. Buell of the Rocky Mountain Station.

Some expansion of watershed studies was made possible by funds received through two cooperative projects. In November 1955, an agreement was signed with the City of Portland Water Bureau establishing a jointly financed study on the Bull Run drainage of Portland's municipal watershed. The agreement provided for a 20-year study of watershed management conditions and problems with the objective of determining an informed and sound basis for management of this 102-square-mile drainage. Two specific goals of the investigation were: (1) to study possibilities of increasing water supplies through cutting the old-growth stand, and (2) to determine methods of maintaining water quality. Since 1892, when the Bull Run Reserve was established by Congress, the only form of management had been exclusion of human use, including grazing of livestock. For many years, problems of the Bull Run watershed had been the subject of discussions between the city officials and the Regional Office and the object of public interest, chiefly centered on problems of forest protection and management and utilization of an overmature Douglas-fir forest.

The assistance of Marshall Dana, formerly editor of the Oregon Journal and at that time an official of the U.S. National Bank, was a telling factor in persuading the city commissioners to enter into this project. Dana, during his long career in Oregon journalism, had been a strong supporter of forest resource conservation and utilization. The second agreement was with the Pilot Rock Lumber Co., which provided funds for a study of lodgepole pine water-sheds in Oregon's Blue Mountains.

Forest management studies in old-growth Douglas-fir were concentrated on the H. J. Andrews Experimental Forest in 1955. Summarization of several years' studies in regeneration showed that a high percent of south-slope clear-cuts were subject to surface temperatures lethal to Douglas-fir seedlings. Studies of artificial seedbeds and use of vegetative cover crops were underway to find ways of solving this problem.

Records of logging cost data collected from the logging of some 60 million board feet from the H. J. Andrews Forest were analyzed by Professor John Carow, School of Natural Resources, University of Michigan. His study showed that costs on the experimental area were comparable to the regional averages on National Forest timber sales in spite of extra requirements to meet research objectives. Efficiency in felling and bucking showed a steady increase during the 5-year period covered by the records. The shift from a two-man to a one-man crew and improvements in power saws were believed responsible. Tractor logging was less costly than high-lead yarding on this study.

The search for rodent repellents turned up a candidate that appeared promising from replicated tests on two National Forests. WRL-2 was found to be highly effective in protecting seed from rodents in direct seeding operations. In some areas, WRL-2 appeared superior to tetramine and elsewhere on the study areas equally effective.

The brush problem received additional attention during 1955. Red alder was also a problem in obtaining satisfactory regeneration of conifers, particularly in the Coast Ranges of Oregon. A study at Cascade Head showed that red alder can be killed by a basal treatment of 2,4,5-T in diesel oil. It was applied to both individual trees and small groups of trees in the study, giving satisfactory results.

As a result of studies of the problem of restocking brushy areas following clearcutting, the Willamette Research Center developed and published a set of recommendations for cutting practices, slash burning, planting, and chemical control, which would apply to spruce-hemlock and Douglas-fir stands of the Oregon Coast Ranges and relieve this problem.

The brush problem was also acute in southwest Oregon but of a different and more serious nature. Large areas had been taken over by brushfields there, and the problem was to find methods of reclaiming them and restoring a conifer cover. An expanded program of chemical brush control studies in this general area was undertaken by the Siskiyou-Cascade Research Center in 1955.

Brush control studies were also strengthened at the Deschutes Research Center, focusing on developing more precise prescriptions (chemical, carrier, and timing) for eradicating the brush without damaging intermingled ponderosa pine.

In view of the developing interest in tree improvement practices in the Douglas-fir region and to stimulate identifying and locating “plus trees,” a tentative guide was prepared and released by the Station in 1955. A central plus-tree register was also established, which was available to all who wished to enroll candidate trees

Studies made in 1955 confirmed earlier observations that relative order of bud bursting does not change if various stocks of Douglas-fir were moved over a range in distance and altitude. This evidently indicated that bud bursting in Douglas-fir is genetically controlled. A more closely controlled study of this phenomenon was commenced this year in cooperation with the School of Forestry on Oregon State College’s McDonald Forest.

Studies by Tarrant of the influence on soil moisture and surface temperature through brush eradication indicated that this measure could influence regeneration by a substantial improvement in moisture and a slight improvement in temperature.

More effective research in fire and weather relations through cooperation with other agencies became possible in 1955. The U.S. Weather Bureau assigned a research forecaster to Portland and the Oregon State Board of Forestry hired a research meteorologist. The Station fire study staff met with these other fire weather researchers in several meetings to define the fire weather problems and assign priorities. Study of wind in mountainous terrain was given the first priority.

Severe, dry, east winds had long been recognized by fire control organizations as the most dangerous weather element in this region. The more that could be learned concerning this weather phenomenon the more effective the fire control planning.

Publication in September 1955 of “Volume Tables For Pacific Northwest Trees,” U.S. Dept. of Agric. Agriculture Handbook 92, by F. A. Johnson, gave foresters all the important volume tables for the region, 122 in number, under one cover.

A major achievement of Range Management Research in 1955 was the completion of the physical facilities at the Starkey Experimental Range. All the fences were completed and permanent plots were established in each of the 12 experimental pastures. Studies of forage utilization by big game were begun on two pastures. Excellent progress was made during the year in the establishment of herbage production, forage utilization, and soil cover sampling units in the experimental watersheds.

Arrangements were completed for including range management objectives in the cooperative lodgepole pine management project with the Pilot Rock Lumber Co.

The plots established by Dr. A. W. Sampson[13] on the Wallowa National Forest in 1907 were reexamined and photographed during the summer. This was a highlight occasion since Dr. Sampson, in company with Station staff members and National Forest grazing staffmen, made up a party to conduct the revisit to these pioneer plots nearly half a century after establishment. Local Forest Service personnel had visited and reexamined these historic plots a number of times, but this was the first revisit by Dr. Sampson.

U.S. Department of Agriculture Farmers Bulletin 2091, “Seeding Summer Ranges In Eastern Oregon and Washington,” by R. S. Rummel and C. E. Holscher, was released in October 1955. It included guides for reseeding in sagebrush, grassland, and meadow types, and logging-disturbed and burned areas in forested zones. Specific directions were given for what areas to seed, what species of seed to use, and when and how to seed.

Increased allotment of funds for the fiscal year 1957, commencing July 1, 1956, provided the basis for expanding study programs and technical staff. In anticipation, special attention was given early in the year to program review and planning. This included critical examination of problem analyses and updating of priorities. Shortage of trained personnel in certain professional skills was becoming acute as other forest research agencies were also accelerating activities. The timber industry was also expanding research programs in forest management research as well as product research and development which had been attracting major attention previously. This opportunity attracted some forest research scientists, diminishing the available supply for the Station. The forest schools also were giving greater attention to forest and related research. These developments, however, offered many advantages in opportunities for cooperative projects, general enlargement of basic forest information, and graduate training for research-oriented foresters. More and more, the need was for highly trained specialists as forest research became more sophisticated and fundamental in nature. At the same time as multiple use management of forest lands was becoming the objective of public forest-land owners and some private owners, in practice as well as principle, a multidiscipline or task force approach to solving the entire problem instead of single discipline or segmental approach became necessary.

13 This was one of the first studies conducted by Dr. Sampson when he started his distinguished career in range research. After leaving the Forest Service in 1922, he joined the faculty of the Forest School, University of California, retiring in 1951 but remaining active for many years.

In view of these changes in scope and nature of investigative methods and the need for personnel qualified by training, experience, and aptitude, moves were made to strengthen research supporting services to free scientists of diverting jobs. It was decided to decentralize training in statistical methods. Instead of sending a few people each year to Washington, D.C., for the 12-week course under Osborne, a 2-week course was held at Wind River, conducted by Floyd Johnson. This was attended by 20 trainees on an experimental basis. It proved successful and apparently better met the needs of the current staff and was less costly than the Washington Office course. The cost in research time and money of the latter program was not always justified by results, based upon this Station's experience of a number of years. Polling of trainees who had taken the Osborne course had raised questions regarding its effectiveness. It was a heavy does for some of those attending, particularly those who did not have academic training in statistics, and for some who had previous training, a considerable part of the course was repetitious.

This Station entered the electronic age in 1956, the first of the Federal forest experiment stations to take this step. Johnson attended a 10-day electronic data programming course at the IBM office in Portland. Following this, he wrote the first Station EDP program for analyzing lumber recovery data. The machine used in processing this material was an IBM 650, located at the IBM office in Portland.

Important changes in personnel occurred in 1956. Leo A. Isaac retired October 1, 1956, after 36 years in the Forest Service, 32 of which were at this Station. Isaac was widely recognized as an outstanding authority on Douglas-fir silviculture. His observations and studies were the foundation of an enlarging body of silvicultural knowledge of this important conifer. Leo had the faculty of not only developing through research essential information but also showing practicing foresters how to apply it in a practical manner, not only in this region but also in other parts of the world where it was introduced. His accomplishments were noted in 1954 when he received the U.S.D.A. Superior Service Award for "outstanding achievement and worldwide recognition as the outstanding authority on Douglas-fir silviculture." In 1956 a similar award was given him by the Society of American Foresters.

In 1956, Station Research Paper 16, "Place of Partial Cutting in Old-Growth Stands of the Douglas-Fir Region," by Leo A. Isaac, was published. His conclusion was that the partial cutting system of the 1930's had not been a successful method of harvesting the crop and converting normal virgin old-growth Douglas-fir stands to new or thrifty stands on average or better sites in this region.

Late in 1950 and early in 1951, the revision and publication of Isaac's "Reproductive Habits of Douglas-Fir" as discussed through an exchange of correspondence. In June 1954, a prospectus of the publication was approved by memorandum of F. H. Eyre, Chief of Forest Management Research, Washington Office, and requested that a detailed outline be prepared and submitted. The outline was sent by the Station director to the Washington Office.

Before retirement late in September 1956, Isaac submitted a draft of a manuscript to the director which was titled, "Natural Reproduction of Douglas-Fir," as a candidate for a Departmental bulletin. Early in 1954 the manuscript was submitted to the Washington Office after preliminary review by Meagher and Cowlin. Eyre suggested we send it to the Washington Office for review and editing by their editor, Robert F. Hall, which was done. April 1957, Eyre returned the manuscript suggesting major revision and inclusion of new data. He proposed we assign a Station staff member to the job who could spend a major effort on it. Dimock was assigned this task which was to take considerable time.

Leo's contributions to progress in forestry did not end with retirement from the Station. He was given a 30-month assignment with the FAO organization of the United Nations to Turkey to assist them with forestry problems. At the close of this job, he traveled through Western Europe and the British Isles on a special Douglas-fir seed use assignment. The latter assignment was partly financed by the Manning Seed Co. of Seattle, Washington, who marketed Douglas-fir seed in Europe.

Another loss to the Station during 1956 was the transfer and promotion of G. Lloyd Hayes, leader of the Siskiyou-Cascade Research Center, to the Rocky Mountain Station at Fort Collins, Co., as Chief, Division of Forest Management Research. William E. Hallin, silviculturist, California Forest Experiment Station, was selected as Lloyd's successor. Hallin, who had a number of years in forest management research in ponderosa pine and redwood in California, reported to Roseburg early in 1957.

Game-habitat research was added to the Range Management Research program as additional funds became available. Previously, studies in this field were minor in nature. Habitat studies were either started or planned for early initiation on both deer and elk ranges in Oregon and Washington.

Grazing management studies were being made in central and southern Oregon with emphasis on the livestock-big game relationships by the Deschutes Research Center staff. In the central Oregon area, 18 major deer herds were recognized. Winter ranges for many of these herds were in critical condition. Areas of direct competition between livestock and big game exist in this area, particularly where livestock use the range in summer and fall and big game in fall and winter.

A study to determine effectiveness of various chemical deer repellents on ponderosa pine seedlings was commenced during 1956 in cooperation with the U.S. Fish and Wildlife Service.

Studies of big-game range by the Mid-Columbia Research Center in central Washington were concerned with habitat management and with relation of site factors to seedbed preparation and establishment of game forage plants on low-capacity ranges. Burt R. McConnell, who had training and experience in wildlife management research, with the Idaho State Game Commission, was added to the staff of the Mid-Columbia Center in September 1956.

The Blue Mountain Research Center continued to be the major field unit in range management research. The Starkey pasture studies were in the third year of the 10-year plan, and variations in cattle weight gains between the several systems of management were becoming more apparent.

The prescribed burning studies of stagnated ponderosa pine range on the Colville Indian Reservation were showing the value of this practice, provided certain important limitations were observed.

Study of the effects of logging on forage, carried on for the past 7 years, showed a major turning point between the fourth and seventh years. Total plant coverage was reached by the fourth year, but the flush of growth was predominantly weeds. After the fourth year, the weeds declined and grasses continued a steady growth, regaining their prelogging status by the seventh year. Shrubs also approached their former abundance by the seventh year.

During 1956, a survey was made in central Oregon of the sagebrush-juniper grasslands in central Oregon, preparatory to making a problem analysis of this type. Two relict areas were located to use as benchmarks for condition and trend studies.

Watershed management was another expanding activity during 1956. Plans were made for initiating watershed studies in the Siskiyou-Cascade Research Center province. Although the watershed study program in other parts of the region was still largely in the planning stage, some of the studies underway were promising early returns. For example, the Corvallis watershed cooperative study showed that all three of the clearcut units, which had been logged and severely slash-burned, showed significant reductions in organic matter, total soil aggregation, and moisture-retention ability. In the Mid-Columbia province, a tentative erosion-hazard index had been developed for soils. Problems concerning soil stability and erosion had long been troublesome for forest- and range-land managers.

In the Blue Mountain province, a survey of lodgepole pine stands during the summer of 1956 revealed characteristics important to watershed management. Regardless of heavy overstocking of the stand, a surprising amount of light penetrated the canopy. This was attributed to the relatively short crowns which also permitted large amounts of precipitation to reach the ground compared to the mix-conifer types occurring on similar sites in the province. A block of plots was established in the Grand Ronde River drainage to learn if lodgepole could be harvested in a manner resulting in greater snow accumulation and delayed melting.

Three small study watersheds were selected in the Bull Run watershed near the south boundary. A trapezoidal mountain flume with gauging house and recording instruments was installed in the first of these sites.

During 1956, the most noteworthy program addition was the initiation of forest management studies at the Blue Mountain Center. In cooperation with the Pilot Rock Lumber Co., a preliminary survey was made of stand and soil characteristics of lodgepole pine stands. Fieldwork was started in June and completed in November. With this information, key research problems could be identified for this long-neglected forest type.

A major job for 1956, in which the entire Forest Management staff participated, was the preparation of a national manual, “Silvical Characteristics of Important Forest Trees of the United States.” All available information for 13 tree species native to the Pacific Northwest was compiled. Manuscripts by individual staff members were prepared, reviewed, and revised by the year’s end, ready for final editing and submission to the Washington Office.

Tree-improvement programs were beginning to yield results. Studies of Douglas-fir pollen dispersion in 1956 indicated that it might be difficult to isolate Douglas-fir seed orchards from outside pollen contamination. A plus-tree register was started at the Bend Forest Service nursery to preserve ponderosa pine trees that showed exceptional characteristics. A study of grafting methods suitable for ponderosa pine under the very dry atmospheric conditions in this area showed the cleft graft to be superior to other methods. This method exposed the minimum cut surface to the dry air.

In November 1955, an unusually severe and unprecedented cold wave struck western Washington and western Oregon. This cold wave caused heavy damage to young forests. Observations made in western Washington early in 1956 showed that of the native trees, western hemlock was hit the hardest, followed by western redcedar and Douglas-fir. Several native hardwoods were seriously damaged. Sitka spruce and the true firs were little damaged. Plantings of Port-Orford-cedar and coast redwood, growing out of their natural range, were often killed outright.

In 1933, a 4-year-old Douglas-fir plantation at Wind River was interplanted with red alder. A 1956 study showed that the soil under this mixture contained more nitrogen, calcium, and magnesium than the soil under pure Douglas-fir. The study also showed that total basal area of both species was almost double that for Douglas-fir alone. Height and diameter growth of Douglas-fir in the mixture compared favorably with that of Douglas-fir alone. The alder was subjected to recurrent winter damage attributed to its sea level source. The test planting was at 2,400 feet elevation, enabling the Douglas-fir to compete with a fair degree of success. Conclusions were that alder might have value as a nurse crop for Douglas-fir. Further studies of this potential were planned.

Increased funds made possible expanded studies in artificial regeneration, a problem area in need of answers. Currently, about 75,000 acres a year were being planted in the Pacific Northwest at a cost of $2.25 million. At the same time, about 300,000 acres were being clearcut annually. Much of this area restocked naturally. However, there was a backlog of old cutovers and deforested burns that were either nonstocked or poorly stocked and in need of artificial regeneration. Obviously, an expanded program of planting and direct seeding was needed involving large sums of money, adding emphasis to the search for additional information on regeneration problems. This problem illustrated the need for a multidiscipline approach, involving silviculturists, geneticists, soil scientists, fire researchers, forest entomologists, pathologists, and economists. James Trappe was added to the staff February 1956 and assigned to regeneration studies.

Considerable more effort was given regeneration problems in southwestern Oregon, where climatic and soil factors were less favorable than in other parts of the Douglas-fir region. Seed spotting of ponderosa pine and sugar pine was showing good success when results of previous year's seeding were examined in 1956.

Studies of the survival of planted Douglas-fir were directed towards various treatments such as depth of planting, transpiration inhibitors, and top pruning, and influence of shade. The latter distinctly showed a marked benefit to survival. Gopher activity was generally an important cause of mortality.

Brush control studies in this province and in the Deschutes area were intensified with more species and more herbicides tested.

Recent examination of the series of burned and unburned slash plots following staggered setting or patch cutting showed that burning greatly reduced fire hazard but did not exert a marked effect on natural regeneration establishment. Neither was there evidence of appreciable damage to soil properties since most slash areas were burned when the duff was moist. Only a small percent of the area was burned severely.

Cable logging with a mobile yarding machine to recover mortality on leave settings on the H. J. Andrews Forest gave some promise. Costs seemed to be within reason and damage to live trees was not unusually severe. However, much depended upon the interest and caution for the reserve stand given by the operator. The cost study was made in cooperation with the Skagit Iron & Steel Works of Everett, Wash.

Analysis of 42 years of recording growth in a fully stocked, site III stand of Douglas-fir at Wind River demonstrated how increased yield can be realized through periodic thinnings. Mean annual increment of this stand culminated at age 81 in cubic feet and age 86 in board feet, Scribner rule. In 1956, the stand was 114 years old and mean annual net increment had decreased 22 percent in cubic feet and 14 percent in board feet. On the other hand, the mean annual gross increment of 762 board feet at 114 years was greater than at any earlier year.

A systematic sampling during 1956 of 50 lodgepole pine stands in the Blue Mountains provided the first positive data on age and structure of the stands and their soil characteristics. Most of the stands studied ranged in age from 55 to 70 years and were essentially evenaged, usually established after fire. Lodgepole pine occurred only on the pumice soils and characteristically on north slopes.

A 1956 study of relative site indexes of sugar pine and Douglas-fir in the South Umpqua drainage confirmed earlier observations of correlation. It was found that 3,500 to 4,000 feet elevation marks the approximate upper limit of sugar pine management units in this area. Close correlation between site indexes of two species furnishes the basis for determining more precise boundaries of management units on the ground.

State agencies and the timber industry were beginning to undertake forest disease research by 1956, stimulated in part by the findings of the Timber Resource Review, which emphasized the losses of timber resource values from growth impact of forest tree diseases. In addition, the expansion of forest tree nurseries, both public and private, and growing acreage of plantations called attention to nursery and plantation diseases.

Root diseases continued to occupy a considerable portion of the staff's time with *Poria weirii* a major offender. Freedom from the disease by western hemlock when it succeeded Douglas-fir in *Poria* infection centers led to the prospect of using this species as a substitute for Douglas-fir on certain sites favorable to hemlock where Douglas-fir productivities had been reduced by the root rot. The 1956 survey showed no extension of *Phytophthora* root rot in native Port-Orford-cedar stands, an encouraging condition.

Extensive dying of bitterbrush, an important browse plant, particularly for big game, was found to be caused by *Armillaria mellea,* a common root rot of forest trees. This disease is difficult to identify, and it may be that it was responsible for much of the bitterbrush damage that was occurring in eastern Oregon.

Cooperative forest insect surveys, made in 1956, of the 45 million acres of forest land in the Pacific Northwest, showed that for the third successive year insect outbreaks had diminished in area. Balsam woolly aphid *(Chermes)* was an exception, and this pest continued extensive damage to true fir stands. As a result of the decline, aerial spraying against the spruce budworm was suspended for the first time in 7 years.

Natural control was an important factor in spruce budworm control in 1956 as parasitism increased. Long-term studies of natural causes of the rise and decline of budworm activities continued.

Owing to the general decline in activities of the Douglas-fir beetle, the cooperative research program was directed toward study of the behavior of the insect under “endemic” conditions. During 1956, the Station started a study of the relationship of killing by the Douglas-fir beetle to amount and location of wind-thrown timber. Initial examination of data suggested strong correlations.

Continuation in 1956 of a 1955 study of this beetle breeding in slash on clearcuts confirmed the conclusion that such slash is not a beetle hazard.

Cooperative research by the Station and Weyerhaeuser Timber Co. on *Chermes* was aimed at determining trends of infestation, biology and habits of the insect, and causes of natural control. This insect deforms and kills trees by attacking twigs, branches, and bole.

Commencing in 1955 and increasing in 1956, a better balance in the work program of Forest Economics Research was being accomplished through allotment of funds for general studies in forest economics. Forest survey, however, continued to be the major activity of the division. Previous to this time, economic studies made were either closely related to the several phases of the forest survey or were financed by cooperative funds.

Although the forest survey reinventory period was still undesirably long, progress was being made in reducing the interval. At the rate of progress for the 4-year period of 1953 to 1956, inclusive, the reinventory cycle was shortened to about 12 to 13 years, not far short of the 10-year target. A major change in the forest survey data processing methods was in process at this time. Advent of the electronic computer promised a considerable saving in time and money. At this time, forest survey data were being tabulated and summarized manually. Machine computation of the tabulating type had been considered as a substitute for the manual process, but the initial cost could not be justified, a fortunate circumstance as this equipment was destined for obsolescence in a few years.

In connection with the forest reinventory of Lane County, Oregon, a more intensive study was made in cooperation with the Lane County Chamber of Commerce of the county’s forest resources and their utilization. Lane County, owing to the quantity and character of its forest resources and its industrial development, was a key area in the timber economy of this region.

With the increased funds, a start was made on the forest products marketing studies. McMahon was moved from the forest survey group to assist McClay on economic studies. A study was made of lumber price trends and relationships of ponderosa pine from 1936 to 1955, and a similar study was made of Douglas-fir for a 5-year period. Among other uses, these data were useful in National Forest timber appraisals.

An analysis was made by McClay of potential production levels by 1960, 1965, 1970, 1975, and 1980 for the various forest industries. This project was undertaken to furnish data for power requirement projections in revising the Corps of Engineers 308 Columbia Basin report.

In the fall of 1956, all aerial-survey techniques studies were consolidated into a research project under the leadership of Pope. Other members of the team were Wear and David Bernstein of the Timber Management Division, Region 6. Wallace Guy[14] was also assigned to the project as aerial photographer and darkroom technician. For the time being, aerial survey techniques studies underway by the Division of Forest Economics Research and Forest Insect Research were continued until completed or incorporated in a new long-range plan which would be made soon. Generally, work was to be concentrated on insect-damage evaluation, forest survey, and National Forest working circle inventory. Other problems sure to arise would be considered for study as they developed.

During 1956, the Division of Forest Products Utilization Research gave major attention to an appraisal base study, which was started in 1955 to gather data for use in appraising Federal timber. In November 1955, Edward H. Clarke joined the Station staff through transfer from the Madison Laboratory and was assigned to this project. Currently, the base for appraising stumpage for National Forest timber sales in the Douglas-fir subregion was log prices. This was the traditional method used when there was a competitive log market in a number of geographic areas. However, in recent years, open market activities had declined to the point where what log price data were available were not reliable for appraisal purposes. Accordingly, the appraisal system was being converted to an end-product method, using the selling price of lumber, plywood, and other primary products as a base. Before such a system could be established, much information on production costs, selling prices, and yield of lumber, plywood, and other products from the various species, grades, and sizes of logs were necessary.

The Forest Utilization staff made lumber recovery studies for western hemlock, white fir, and western redcedar during 1956. Six veneer recovery studies were also made during the year.

Progress of the skyline logging experimental sale on the Okanogan National Forest had disclosed some short-comings in the Wyssen skyline crane. It was not entirely suitable for conditions in the Pacific Northwest. The output per man-hour and load capacity were too low and the loading and unloading systems were unsatisfactory. To over come these faults, Wyssen designed a new machine capable of handling 5-ton loads.

Periodic inspection of four bridges constructed with glued-laminated structural beams and arches of Douglas-fir showed that the glue bonds were maintaining strong, dependable joints.

During 1956, the report, “Cost of Hauling Logs by Motor Truck and Trailer,” by J. J. Byrne, Roger J. Nelson, and Paul H. Goggings, originally published by the Station in 1947, was made current and reissued. Demand for this publication was heavy and the original printing was exhausted.

14 Guy was first employed at the Station on a temporary basis in 1954, and was given full-time appointment in 1955. In fiscal year 1956, the Sellwood building was transferred from Region 6 to the Station. Guy made plans and supervised construction of a photographic laboratory in the building.

In 1939, Region 6 acquired carbarns and an office building in Sellwood from the Portland Traction Co. These buildings serviced the electric interurban line between Portland and Oregon City which commenced operations in 1893. The Region used these buildings for equipment, management shop repairs, and storage. In 1953-54, the Region moved this facility to a new structure on N.W. Yeon Street in Portland. The carbarn was sold by the GSA to a private party. The Station moved into the office building, which had a fenced compound, and used it for insect-rearing cages and automobile storage as well as a photographic laboratory. Over the years it served other purposes as well. This facility was a great improvement over the darkroom and insect-rearing facilities in the U.S. Court House which were used prior to 1954.

Major effort in forest utilization research continued to be directed to the appraisal base study during 1957. The use of electronic data processing greatly shortened the computation phase of this project, which previously had consumed an inordinate amount of time. An IBM program, developed at this Station for grade recovery studies, was adopted by other western offices of the Forest Service for use in similar studies.

Four grade yield lumber recovery studies were made by the Station during 1957 in cooperation with the Regional Office and other public agencies. Studies included east-side and west-side Douglas-fir logs, sugar pine, and ponderosa pine. Help was given Region 10 on a lumber recovery study for Sitka spruce at a mill in Wrangell, Alaska. During 1957, the Division of Timber Management, Region 6, commenced using pond-log values, developed by this project in current stumpage appraisals on National Forest timber sales.

The first skyline crane sale on the Chelan National Forest,[15] made in 1954, was completed in October 1957 using the Wyssen 3-ton crane. Analysis of data from this operation demonstrated that it was feasible to log some areas currently considered inoperable. In mid-1956, the Okanogan National Forest made a sale of 100 million board feet, of which 8 million feet, on land previously classified as inoperable, was to be logged with some type of skyline cable system. The Douglas-fir subregion also had large areas of timber which were best suited to this type of logging; the new 5-ton Wyssen crane currently building in Switzerland was considered heavy enough for Douglas-fir logging.

Corrugated fiberboard containers replaced wooden boxes for shipping apples over the past few years, creating a problem for growers in eastern Washington and Oregon. The fiberboard container could not be used as a picking lug in the orchards since it was not waterproof. In 1956, the Forest Products Laboratory and the Station cooperated in designing and trial of a palletized wooden bin for moving apples from orchard to packinghouse. These binds, holding some 25 to 30 bushels, were loaded and unloaded with forklifts, facilitating bulk handling. In 1957, over 24,000 of these binds were used in the Wenatchee-Yakima area.

The Station, in cooperation with the Madison Laboratory, had been studying house paint performance on wood siding for a number of years. A common paint failure in western Oregon and western Washington had been blistering and peeling of siding. The cause of much of this condition was wind-driven water entering at horizontal lap joints and at end joints, wetting the wood under the paint surface. Treatments of toxic water-repellent primer applied before painting were giving satisfactory results after 5 years of observation.

A study of the effect of continuous water sprinkling of cold decks containing western hemlock logs was completed in 1956. This procedure effectively prevented progress of decay over a 2-year period; commonly, logs are not stored in cold decks for longer periods.

Martin E. Baudendistel, Chief of the Division of Forest Economics Research, died June 18, 1957, after an illness of several months. This was a severe professional and personal loss to the Station. Moravets took over his responsibilities.

15 Later in 1954, the name of the Chelan National Forest was changed to the Okanogan National Forest, following some boundary changes involving the Wenatchee National Forest.

For the past several years, the forest survey inventory program was closely coordinated with the related program of timber surveys on National Forest working circles made for management planning. A joint program for reinventory of National Forest land by Administration and Station people, made concurrently with reinventory of other forest lands in a county by Station personnel, was proving efficient and economical. A similar cooperative program was developed with the Bureau of Indian Affairs for inventory of forest lands of the Spokane and Colville Indian Reservations in northeastern Washington.

In 1957, studies were initiated by the forest survey and National Forest Administration to test the efficiency of a systematic grid of permanent sampling points for determining timber volume and forest area. For the past decade, location of sample plots for timber volume inventory for all forest lands was based upon random selection on aerial photos. It was believed that the new systematic grid of permanent plots would provide valuable trend information for future analysis and also provide greater opportunities for cooperative inventories by public and private forest-land owners. Such agencies could use data from these plots as a base for more intensive inventories of their lands.

During 1957, about 2.7 million acres on nine working circles of National Forest land was covered through the joint efforts of Station and Administration crews and about 2.0 million acres of other forest-land owners was covered by Station crews alone. The yearly total of 4.7 million acres was about 9 percent of the region's forest land, which nearly met the objective of a 10-year inventory cycle.

Johnson prepared a series of EDP programs for the inventory and growth phases of the forest survey, which were used for the first time in 1957.

In addition to the county statistical reports, the forest survey staff published a comprehensive report on the forest resources and timber industries of Lane County in 1957. This county led all others of the Pacific Northwest in production of timber products. Over half of all employment and payrolls in the county was from the forest industries. Since the beginning of the forest survey, staff members "doubled in brass." County crew leaders prepared the county reports following close of the field season and also prepared or assisted in preparation of special reports as the occasion required. However, some of the staff showed special aptitude for preparing analytical and interpretive reports. Over the years, Moravets did much of this work in addition to his administrative responsibilities for the forest survey. With expanded activities in the inventory program, further specialization in functional responsibilities were evident. Gedney, for the past year or more, spent full time on special analyses and report writing. For example, in 1956, a joint study of mill residues resulted in publication of "Mill Residues in Three Oregon Counties," Oregon Forest Products Information Circular 8, by S. E. Corder and D. R. Gedney. The latter was also. the author of "Annual Cut and Timber Products Output in the Pacific Northwest in 1952, a Station release. In 1957, a section of the forest survey called resource analysis was established with Gedney in charge.

A further step in organizing the Division of Forest Economics Research in functional fields of study was establishment of a section of economics of forest management, forest utilization, and forest products marketing, headed by McClay and assisted by McMahon and Adams.[16] This section continued studies of lumber and plywood price trends during 1957. A study of Douglas-fir stumpage prices and trends on National Forest and BLM timber sales in the Douglas-fir subregion was made in 1957 for the period 1944 to 1955. A cooperative study of marketing practices and prices from farms and small private holdings in western Oregon was made by McMahon in cooperation with the School of Forestry, Oregon State College. A study of lodgepole pine, its present use and future markets was also made by McMahon.

16 Dr. Thomas C. Adams joined the Station in 1951 and was assigned to the Siskiyou-Cascade Research Center. In July 1952, he was given permanent appointment on the forest survey staff. In 1957, he was reassigned to forest products marketing studies.

Adams commenced a study during 1957 of Christmas tree production and marketing in cooperation with the Oregon State Board of Forestry, Washington State Department of Natural Resources, and Region 6 Division of State and Private Forestry.

The balsam woolly aphid continued its destructive spread in true fir stands during 1957 which stimulated increased research on this insect, lessening research efforts on other forest insects. A predacious fly, *Aphidoletes thompsoni,* was imported from Europe in an effort to control this immigrant pest through biological measures. Special techniques were developed and used in a cooperative study to appraise accumulated damage by the aphid in heavily infested areas in Washington. A preliminary survey disclosed several native predators of the aphid. However, it appeared to be more effective against low populations than against high populations of this damaging pest.

Sudden and inexplicable declines in outbreaks of the eight species of bark beetles infesting various species of pine and fir in the Pacific Northwest suggest that diseases might be responsible. Cultures for study were made of external and internal microorganisms associated with these beetles. In September 1957, C. M. Thomas[17] was temporarily assigned to the California Station to work with insect pathologists of the Department of Biological Control at the University of California at Berkeley.

The cooperative forest insect survey of the Pacific Northwest showed an increase in outbreaks after 3 successive years of declined activity. This called for renewed spraying on budworm infestations in 1958.

A new insect survey project was started in 1957 in cooperation with Oregon State College to study insects attacking range plants in Oregon. The study was centralized at the Deschutes Research Center and commenced with an inventory of insects occurring on important browse plants and bunchgrasses.

An analysis was made in 1957 of the forest disease problem in the Pacific Northwest as a whole in order to concentrate available resources most effectively. Some two score forest tree diseases had sufficient impact upon Pacific Northwest forests to merit consideration in rating study priorities in view of manpower limitations. Considerations in evaluation were value of the forest host, damage potential, prospects of useful results, availability of existing information, and qualifications of available personnel.

As a result of this analysis, high priorities were given root rots of Douglas-fir and ponderosa pine, dwarfmistletoes on these two species, decay of killed timber, ponderosa pine needleblight, diseases of Douglas-fir and ponderosa pine seedlings, heart rots of true firs and young-growth Douglas-fir, and white pine blister rust. Obviously, other diseases showing up could not be ignored, but the main thrust was planned on the above list for the immediate future. For example, needleblight of western larch was found to be unusually abundant in 1957. However, this disease, which is closely related to ponderosa pine needleblight, is not only less injurious than the latter but the host tree is of much lesser importance. Killing of lodgepole pine foliage by an unidentified fungus was observed commonly in parts of eastern Oregon during 1957. Currently, losses were not significant enough to justify intensive study.

A number of publications were produced by the division during 1957, chiefly by Hunt and Wright.

17 “Bud” Thomas joined the Station staff in 1953 upon receiving a master’s degree from Syracuse. The California assignment was arranged for him to take Ph.D. training under Dr. Steinhaus of the university faculty and an outstanding authority on insect pathology.

Overshadowing all activities of the division during 1957 was the tragic death of Dr. John Hunt on August 24. John, a promising young scientist, was offered and accepted a position on the faculty of the School of Forestry, Yale University. He was en route to this new position when he was murdered by a transient criminal in southern Idaho, a severe shock to the Station staff and his many other friends and associates in this region. John was on his way to national prominence in his profession, and great things were expected from him in future years.

Important changes made in the Forest Management Research program in 1957 included greatly expanded work on lodgepole pine management at the Deschutes Research Center. A large lodgepole pine pulpmill was constructed by the Johns Manville Co. near Chiloquin in south-central Oregon. Plans were announced in 1957 for construction of an additional large pulpmill to use lodgepole pine and other central Oregon species.[18]

A section of artificial regeneration and soils was established in 1957 in the Division of Forest Management Research to implement an integrated approach to solving problems in seeding and planting. Both the Station and the National Forest Research Advisory Committees had discussed and endorsed this action. Greater emphasis was planned for research directed to more rapid and effective restocking of cutover and burned lands by planting and direct seeding.

Cooperative studies with the Oregon Seed Laboratory at Corvallis and the Regional Office demonstrated the prospect of artificial ripening of Douglas-fir seed from early picked cones. Use of this practice would extend the cone-picking season several weeks.

A 10-year record of a test plantation in the fog belt of the Oregon coastal area showed the need for detailed planning to obtain adequate regeneration promptly. Factors to be considered were exposure, topography, period between slash burning and planting, need for followup control measures in areas subject to aggressive competition from brush and hardwoods, and identification of areas likely to regenerate naturally.

Severe rabbit damage to trial plantings of Douglas-fir, established to determine effect of bracken fern control and fertilization upon seedling growth at the Hemlock Cooperative Experimental Forest, led to some unexpected findings. Two significant correlations occurred: (1) rabbit clipping was most severe where bracken fern was periodically cut away from seedlings, and (2) there was a tendency toward more clipping on fertilized trees.

Accumulation of data during the past decade on commercial thinning of Douglas-fir in the Pacific Northwest, much of it collected from the studies on the cooperative experimental forest, provided the basis for preparation of a departmental publication. A revised manuscript was being reviewed by a score of foresters from other agencies and industry during 1957 preparatory to final editing and publication.

Thinning studies in the ponderosa pine subregion were reaching the point of conclusive returns, also in 1957. Results of remeasurement of plots originally thinned at the Pringle Falls Experimental Forest in 1934 showed optimum benefits from moderate thinning. Heavily thinned stands, although superior in growth to unthinned stands, were inferior to those moderately thinned.

Chemical thinning of ponderosa pine young growth appeared to be inexpensive enough to be practical for stands containing medium-sized poles. Additional research was needed, however, to develop treatments that would curb beetle populations in the killed trees which could be detrimental to the reserve stand.

18 For a number of reasons, these plans were not consummated. Course of events in later years altered basic considerations essential for successful operation.

Red alder, the most widespread hardwood of the Pacific Northwest and the one of greatest significance as an industrial raw material, was receiving increasing attention in the Station's program. This species was most common in the coastal mountains and reached optimum development there. It occurred in pure stands and in mixed alder-conifer stands. Studies to determine factors affecting growth and behavior of mixed stands, pure alder, and pure conifer had been conducted at Cascade Head since 1935. This area was admirably located for such studies which were producing tangible results at this time. Periodic annual growth, based upon 1956 measurements for treatments at age 10 years, was for (1) unthinned alder-conifer, 244 cubic feet per acre; (2) unthinned pure alder, 266 cubic feet; (3) thinned to pure alder, 249 cubic feet; and (4) thinned to pure conifer, 401 cubic feet; indicating that releasing well-spaced conifers by removing alder was a promising treatment of 25- to 30-year-old mixed stands.

To gather additional information on the place of red alder in soil nitrogen development, root samples of this species were sent to Dr. G. Bond, University of Glasgow, United Kingdom, for inclusion in his experimentation with nodulated nonleguminous plants. Dr. Bond, an international authority, found that nitrogen fixation proceeded normally in newly formed nodules when other species of *Alnus* were inoculated with red alder root nodules. This opened the way for using European research results on soil-improving benefits of alder in red alder *(Alnus rubra)* management.

Preliminary analysis of data from 400 sample plots, taken by some 50 public and private cooperators, was commenced to develop yield tables for red alder. This project, sponsored by the Puget Sound Research Center advisory committee, covered the range of this species in this region.

Studies of growth of reserve stands in selectively cut ponderosa pine gave evidence that over the wide range of conditions sampled, age and vigor of reserve trees and their distribution were dominant factors rather than method of cutting or reserve volume.

Watershed management research in the Pacific Northwest was finally coming into its own under Dunford's vigorous leadership. During the past few years, the staff had expanded, and in 1957 included six professional personnel who were spending all or the major part of their time on watershed management problems on five separate forested areas of this region. The staff, consisting of Dunford, Nedavia Bethlahmy, David D. Wooldridge, Jack S. Rothacher, Harold G. Herring, and Norman Miner, had varying degrees of training and previous experience in this comparatively new field of forest science research.

In order to give this new group a rapid on-the-job training, the entire professional staff spent 3 weeks on an itinerant seminar, visiting watershed research installations and studies at other western Federal forest experiment stations.

Obviously, it was far too early to expect conclusive results from going studies in this region since installation was too recent. Preliminary findings were accumulating and were being disseminated in progress reports and in the 1957 Annual Report. Major effort, however, was in measuring and recording information on existing installations and laying out new projects.

In 1957, the current programs of Watershed Management Research included: (1) forest cover and streamflow studies in Douglas-fir forests on the Andrews Experimental Forest and the Bull Run watershed; (2) studies of forest cover and precipitation in the lodgepole pine forest on the Blue Mountains of eastern Oregon and in Douglas-fir forests on the western slopes of the Cascade Range of west-central Oregon; (3) studies of normal erosion under virgin Douglas-fir forests on the Andrews Forest and of induced erosion on two soil-disturbed areas in north-central Washington, one logged by the Wyssen skyline system and the other by ground tractor skidding; and (4) development of research methods and equipment for studying soil stability, soil erosion, and measurement of precipitation.

In March 1957, Robert W. Harris, leader of the Blue Mountain Center, was transferred to the Washington Office as Assistant Director of the Division of Range Management, National Forest Administration. Harris had been leader of this center since September 1954 when he replaced Clark Holscher who had also moved to the Washington Office, Division of Watershed Management Research, as assistant to Dr. Herbert Storey, chief of that division, following a tour of duty with the FAO. Harris was replaced at La Grande by Merton Reed, transferred from the Division of Range Management Research in the Washington Office.

The year 1957 was the first full year of research in an expanded program of range and game forage. Big-game habitat studies were underway on both deer and elk ranges in Oregon and Washington. These studies included livestock-big game relationships, habitat management and improvement, ecological requirements of game forage plants, and methods of sampling vegetation on big-game ranges. Studies in the ecology and physiology of range plants at this time were concerned with bitterbrush and elk sedge *(Carex* spp.).

Browsing by elk on Douglas-fir plantation on clearcut patches and deforested burns on the Olympic National Forest was causing severe losses. In 1957, a joint study to determine the extent and duration of browsing damage was undertaken by personnel from the Mid-Columbia and Puget Sound Research Centers and the Olympic National Forest.

In central Oregon, exploratory studies of chemical repellents showed that two deer repellents, TMTD and ZAC, showed promise to reduce browsing damage by this animal on ponderosa pine seedlings.

In 1957, seasonal weight gains of heifers and steers grazed on the open range at Starkey Experimental Range were recorded for the first time. Such data were recorded for cattle on the Starkey experimental pastures for the past 3 years as part of the deferred-rotation season-long grazing project.

Results of an analysis of the advantages of hauling water for range cattle were summarized in U.S. Department of Agriculture Leaflet 419, 1957, by David F. Costello and Richard S. Driscoll.

During 1957, the consolidated aerial surveys techniques staff made substantial additions and improvements in its equipment. A new plane, a Cessna 180, was acquired. This model had superior cruising speed, rate of climb, and service ceiling than the replaced plane and would add greater efficiency to aerial techniques studies. In addition, an aerial camera with shutter speeds of 1/900 second was acquired to test effects of fast speeds upon photo image quality. A scanning stereoscope was purchased to obtain efficient interpretation of aerial color transparencies, and in 1958 a light table was designed and constructed to facilitate use of the stereoscope.

In the field of forest inventory and management techniques, studies were underway in 1958 on constructing and improving aerial-photo volume tables, photographic assessment of forest site class, and extraction of more detailed forest management information from aerial photography. This led to supplemental studies of the effect of instrument magnification on height measurements made on aerial photos, and the replotting of the standard site curves in a series of straight lines.

Current cooperative studies of mortality from Douglas-fir bark beetle attacks were essentially completed in 1958. The study showed high correlation (correlation coefficient = 0.96) between photo and field counts of current year's mortality caused by this beetle. This meant that during future outbreaks current annual mortality could be obtained through aerial photos at a substantial reduction in overall cost by minimizing field checking.

Further tests were needed before aerial photos could be used to replace a major part of fieldwork normally required to assess loss in epidemic outbreaks of the western pine beetle.

The Station's statistical 2-week training course vas held at the Wellwood Laboratory in 1957 with an enrollment of 18. The following year, Professor Johnson planned an innovation. He developed a correspondence course consisting of 60 lessons. It was still being used in 1974, and several hundred trainees from the Station and other agencies have completed the course by that date, a mark of its success.

In 1958 a Stationwide programmer pool was organized under the direction of Mrs. Dorothy Martin in the biometrics[19] section. Electronic data processing was expanding at this time to cover most of the Station projects if appropriate. The Station, Johnson in particular, assisted other Stations in starting similar EDP programs.

With expanding research programs in scope and intensity, the flow of publications increased in volume and technical substance, overburdening the Station editor. To alleviate this situation, Edith P. Tomkins was added to the staff as an editorial assistant in May 1958 by transfer from the Regional Office. She had reentered the Forest Service in 1948 in charge of the stenographic pool in the Regional Office and later was chief clerk of the Division of Information and Education in that office.

The need for facilities designed expressly for basic forest research was becoming more critical each year. By 1958, encouraging progress was being made by the other Federal forest experiment stations in some other parts of the country. Two laboratories planned for basic research in forest fires, one at Macon, Ga., and the other at Missoula, Mont., were under construction, and other laboratories for research in forest genetics and forest biology were in the planning stage elsewhere. This was only a bare beginning compared to the national needs, and no research construction funds were available for this Station. There were many research problems peculiar to this region which could not be satisfied by results found in laboratory research elsewhere.

Current status of forest insect research programs here illustrated the needs of this region. The only installation available was the Sellwood Laboratory, an improvised facility for insect-rearing cages. The photographic laboratory, however, was proving very successful, particularly in connection with forest insect research. Questions were being raised concerning the use of chemical insecticides and herbicides such as DDT and the environmental consequences. It was about this time or soon after that a series of articles by Dr. Rachel Carson commenced in the New Yorker magazine, pointing in dramatic terms to the potential danger to the environment and man's fate in a polluted world. These articles were published in book form in 1962 under the title, "Silent Spring." Attention in research had been given to biological control before this, but now added emphasis was given. Work in this field could not progress satisfactorily until laboratory facilities equipped with modern scientific instruments and machines were available for conducting basic research to determine fundamental principles. Until such facilities were available, programs had to be tailored to such improvised facilities and methods that were at hand. Some studies could be made through the cooperation of educational institutions that had science laboratories. These efforts, however, were relatively small scale and fragmentary.

In 1958, forest insect research in the Douglas-fir region continued to center on the balsam woolly aphid. Six species of predators, three flies and three beetles, were received during the summer from Sweden, Czechoslovakia, and Japan in the hope of colonizing them in this region. The imported insect predators were released at several locations in western Oregon and western Washington. By fall at least two of them had produced progeny. However, despite this encouraging sign, several years would have to pass before it could be known that the insects were permanently established and that they would be a significant instrument in control of the balsam woolly aphid.

19 New nomenclature comes with advancing sophistication in equipment and technology. This group was formerly called the statistical section.

Fourteen species of true firs[20] were known to be infested with the balsam woolly aphid in this region, including exotic species in arboretums, with varying degrees of damage. A number of native predators of this common enemy were found. The heaviest damage occurred on the three indigenous species, Pacific silver fir, grand fir, and subalpine fir. The other two native species, noble fir and white fir *(A. concolor),* escaped with light damage.

Control operations against the spruce budworm were resumed in 1958 after a 2-year suspension. An area of over 800,000 acres of severe epidemic infestations was sprayed in the Oregon Blue Mountains at the recommendation of the Northwest Forest Pest Action Council. Results were good with a 96.2-percent kill of the larvae. Long-term studies on spruce budworm population trends and effects of natural control agents were largely ended when study areas were sprayed this year.

A comparative study was made of the effects of natural control factors on the black-headed budworm in widely separated areas, one in western Washington, the other in eastern Oregon. There had been spot infestations of this insect recently which subsided naturally with minor damage. However, other infestations could be expected.

For the first time in a quarter of a century, a flight of the Pandora moth occurred in central Oregon, providing an opportunity to study the biology and natural control of this insect. It is a periodic defoliator of ponderosa pine.

Damage from cone and seed insects was causing increasing concern among forest managers as regeneration problems gained in prominence. Less spectacular than epidemic attacks on merchantable timber, these insects could be the cause of considerable loss to forest management programs. Needs for research on control of this order of insects were evaluated at a meeting in 1958 of private, State, and Federal foresters.

Losses from Douglas-fir bark beetle attacks increased regionwide, particularly in southern Oregon and on the Colville Indian Reservation in northeastern Washington. However, reduced populations in the current year and increasing natural control indicated a decline in 1959. An extensive blowdown in 1958 was expected to trigger a population buildup that would be manifested in 1960. Salvage operations were still relied upon to keep this insect in check.

Reducing losses from forest diseases continued to be hampered greatly through lack of basic information. Much information had been accumulated upon the characteristics and behavior of forest diseases under usual conditions. Unexpected departures from regular patterns which disrupt control measures and management practices appear from unknown or unsuspected factors. For example, sufficient is known about the dissemination of dwarfmistletoe in ponderosa pine to undertake control with reasonable expectation of success. Rather frequent vagaries in distribution patterns indicate that better methods of control could be developed if the fundamental reasons for these phenomena could be learned.

Heavy losses from dwarfmistletoe in mature old-growth forests were common in southwestern Oregon. Aerial surveys located a number of areas on the Rogue River National Forest in 1958, calling for immediate salvage programs.

The *Phytophthora* root rot of Port-Orford-cedar continued to spread through the natural range of this valuable species which was becoming scarce from past exploitation.

20 For years, Thornton Munger insisted that the genus *Abies* be referred to commonly as “balsam” firs, not “true” firs. This perhaps was the more classical usage, but it did not take hold in this region.

With an increase in precommercial thinnings of young-growth Douglas-fir stands, scars and decay in residual young trees were an object of study. Early study findings indicated that serious decay in Douglas-fir was not likely, but the thinner barked western hemlock trees would probably lose appreciable volume from decay.

A modest increase in allotments for forest management research in the fiscal year commencing July 1, 1958, enabled the Station to fill a few gaps in the list of live projects. One project was designed to study the silvicultural effects of spruce budworm defoliation on selected stands in northeastern Oregon. Carroll B. Williams,[21] who had graduate training in insect ecology at the University of Michigan, was selected to spend full time on this project. A second new project was in management of the upper-slope fir-hemlock forests of western Washington.

Research in forest genetics was strengthened by the additional funds which were not sufficient to increase the one-man professional staff. The money was used for additional parttime assistants and improvements of three progeny testing areas. The studies commenced years ago were constantly turning up new findings as the data were analyzed critically. A pooling of information from provenance tests of ponderosa pine, established in the early days of this Station and the Intermountain Station, were strengthening the understanding of genetic differences in this westernwide species.

Growth rates of the progeny were found to be consistently related to seed source. Survival was found to be related directly to progeny height growth. Browsing damage by wild animals differed widely. Progeny from some sources were browsed at all planting locations; others were scarcely damaged.

Laboratory tests made in 1958 were providing a more precise measure than field examination of conditions under which Douglas-fir seedlings were damaged by heat. Preliminary results indicated that heat kill depends upon temperature and duration of exposure. Previously, Douglas-fir seedlings were thought to develop heat-resistant tissues a few weeks after germination. The current tests indicated that increase of age up to 3 months gained only minor increase in heat resistance.

Field studies in southwest Oregon showed that sugar pine seedlings responded significantly to release following partial cutting. Additional investigations were planned to determine whether retention and protection of sugar pine seedlings during harvest cutting and slash disposal was a desirable forest management practice.

Two studies provided new leads on environmental requirements for mycorrhizae formation. One, a pure culture test on ponderosa pine, showed that of the several fungi tested, only one formed mycorrhizae when soil temperature reached 30° C. The study on seedlings of ponderosa pine, Douglas-fir, and Monterey pine *(Pinus radiata),* inoculated with mycorrhizae grown in jars immersed in controlled temperature baths, showed development of mycorrhizae was inhibited greatly by 30° C. soil temperature.

Exploratory tests during 1958 gave consistent and surprising results of effect of nitrogen and nitrogen-phosphorus fertilizer on newly planted Douglas-fir and noble fir seedlings. In all cases, fertilization resulted in sharp reduction in survival. However, survivors apparently outgrew unfertilized seedlings. These empirical studies indicated need for more fundamental studies in nutrient requirements of tree seedlings.

21 Carroll Williams was the first black to be employed in the Branch of Research of the Forest Service in a professional capacity. He received his Ph.D. from the University of Michigan in June 1963. The subject of his doctoral dissertation was the

Studies of Douglas-fir stands, following clearcut logging and broadcast burning 5 years or more before 1958, showed that herbaceous species quickly invaded the cutover areas. A total of 104 species or species groups were found; of these, 101 were growing on north slopes and only 65 on south slopes. Annuals occurred frequently the first 2 years and then declined in a definite trend from annuals to perennials. Woody species that survived burning increased slowly in frequency of occurrence. New woody invaders increased at a slower rate than survivors. After 5 years, there was little difference in species composition and plant density between burned and unburned areas.

Project scale aerial application of herbicides showed this could be an effective means of brush control. A foliage spray of a low-volatile ester of 2,4-D was used. In some cases, a second follow-up application was necessary.

Several tests of foliage spray in brush control trials showed that some common herbicides were sufficiently selective to control certain woody plants without lasting damage to intermixed young conifers.

Recent studies of a Douglas-fir plantation on the Olympic National Forest gave extra evidence that Douglas-fir plantations have much higher yields at an early age than fully stocked natural stands of the same age and site.

A time and production study on the Andrews Forest showed that high-lead cable logging with a mobile yarder was a practical method for periodic salvage of leave settings in old-growth Douglas-fir.

Two projects of national importance took a major part of Cramer's time during 1958. He was detailed to Washington, D.C., early in the year to assist in organizing and editing a fire-weather handbook, a joint undertaking of the Forest Service, Weather Bureau, and fire control agencies of the Department of Interior. The central objective of the project was to assemble in readily usable form essential meteorological information needed by fire control personnel. Punctuating this undertaking, the summer of 1958 was the hottest on record for the Douglas-fir subregion.

With the planning stage well over, the Watershed Management Research program was underway with active studies designed to give early answers and others, long range in scope, to solve more complex problems in land use. Major attention was given to studies of soil erosion on logged areas during the year. Absence of solid factual data had led to wide differences of opinion on this subject which was becoming a prime matter of public interest and concern. Increased attention during 1958 was also given to the basic relations between forest cover and snow.

It was generally known that little erosion occurs in undisturbed forest, particularly west of the Cascade Range summit. However, even there some gradual soil movement was taking place. To obtain a measure of normal soil erosion, records were made on three typical, undisturbed, small watersheds on the Andrews Experimental Forest. It was found from 2-year records an average of only 0.036 acre-foot per square mile of drainage moved downstream annually, probably approximating the geological norm. Under flood conditions during the early 1957 winter, the maximum suspended load in the water was only 200 parts per million (p.p.m.). Natural contributions are but a minor part of material carried by major Pacific Northwest streams. For example, 6,850 p.p.m. were measured downstream from cultivated and logged areas in the South Umpqua River in southwestern Oregon. One of the major objectives of the division's program was to find what happens to forest soil when the protective forest cover is removed or altered significantly. Some data were accumulating; two obvious causal factors were skidtrails and logging roads. The latter were known to be one of the most important sources of erosion in logging operations. However, since they usually were an integral part of timber harvesting, it was difficult to assess their relative contribution to stream sedimentation. A specially designed operation on the Andrews Forest was undertaken to obtain separate measurement of this factor. James T. Krygier of the School of Forestry, Oregon State College, was added to the staff on a temporary basis to assist in this study. In 1957, a study of soil movement from existing roads was made in cooperation with the Bureau of Land Management and Oregon State College to determine key sources of erosion.

After a logging operation was completed, grass seeding of skidtrails and other critical areas was known to be effective when used properly. A test on the west slope of the Cascade Range demonstrated the value of using fertilizer to obtain adequate stands of grass.

Early examinations indicated considerable variation in snow accumulation and rates of melt in forested areas. This knowledge was used in designing controlled experiments on the effect of timber cutting on snow.

A quickie study, conducted near Portland, showed that hexadecanol reduced evaporation by 42 percent, corroborating studies made elsewhere. This could be useful in minimizing water losses from reservoirs, ponds, etc., during low water supply periods.

Increasing interest in the long-term timber supply situation in the Pacific Northwest exerted strong influence on the Forest Economics Research program in 1958.[22] A major study was commenced in midyear to assemble and analyze the best available data on quantity and quality of the present and potential timber supply the Douglas-fir subregion could contribute to the Nation's total. Such an analysis must consider the forest-land ownership pattern and limiting factors. An initial step was to develop techniques for the collection, classification, and interpretation of forest-land ownership data as to size of holding, owner intent, and management policy. Related studies were planned to determine the degree of timber utilization, woods, and plant to determine economic feasibility of increasing degree of utilization and to develop estimates of volume and value of salvable mortality in old-growth Douglas-fir stands. In 1958, the Chief of the Forest Service, in response to public interest, asked the Station to undertake an enlarged program of important policy issues. This study was the first to be undertaken in answer to the Chief and later came to be known as the timber trends study.

Dr. William A. Duerr, professor of forest economics on sabbatical leave from New York State College of Forestry at Syracuse, was employed to direct this study, a fortuitous circumstance. Dr. Duerr, author of many publications on forest economics, was formerly Chief, Division of Forest Economics Research at the Southern Forest Experiment Station in New Orleans, La., and a recognized authority in the field of forest resource economics.

In one way or another, this project involved all sections of the Division of Forest Economics. At the same time, work on the forest survey and several economic studies continued on regular courses.

Analysis of 1957 records of Christmas tree production and marketing showed that 2.7 million trees were cut in the two States, two-thirds of which were shipped out of State, chiefly to California. About 60 percent went by rail and the remainder by truck. Private lands furnished 90 percent of the harvest of Christmas trees. Douglas-fir was the principal tree cut.

A "hot" logging study of the degree of woods utilization was made in eastern Oregon. This was the first attempt of this kind where Station crews worked with the felling crews. Previously, such studies were made after yarding was completed and the loggers had moved on.

A study was made of the impact of the 1957 nationwide economics recession[23] on output of timber products in the two States. Timber production in the region had been generally increasing since 1953. Total for 1957 declined to 11.6 billion board feet from 14.3 billion board feet in 1956.

22 "Timber Resources for America's Future," U.S.D.A., Forest Service, Forest Resource Report 14, January 1958, presented the findings of the TRR in final form.

23 The term "recession" gained common currency at this time to separate this slump in business activity from the onus of being a depression like that of the 1930's.

During 1958, electronic data processing programs were developed for calculating estimates of average growth per acre by species for both subregions. These programs found extensive use by other agencies, both public and private, in this region and elsewhere.

Need for information on properties and uses of species from the upper-slope forest types has increased rapidly. During 1958, the Umpqua National Forest made a 75-million-board-foot sale at Windigo Pass on the Cascade crest in southwestern Oregon. Forty percent of the timber volume on this sale was mountain hemlock. Limited previous experience with this species had not provided an opportunity to evaluate problems in its manufacture and marketing. The Forest Utilization staff and the Madison Laboratory commenced work on these problems.

During 1958, the Station's Forest Utilization work was broadened to include the new State of Alaska, and Matson made a trip north to determine ways and means for redeeming this new responsibility.

The appraisal base study underway for the past 3 years was sufficiently advanced to provide the basis for using end-product recovery data in Federal timber appraisals. It was anticipated that development of these data would be a continuing process to keep abreast of changing utilization practices. Improvements were made in the electronic computing programs in 1958 which speeded up analyses and bettered application. A shift was made from determining grade yield recovery as a percentage of net log scale or lumber tally for each log diameter within a log grade to establishing end-product values by diameter.

The Forest Products Laboratory started a nationwide study to measure moisture content and dimensional changes in wooden framing members of houses during construction and occupancy. This Station and the West Coast Lumbermen's Association cooperated in selecting test houses and taking field data in this region. Among the Pacific Northwest test houses were three identical residences under construction in 1958 at the Chelatchie Prairie Ranger Station (also called the Lewis River district) on the Gifford Pinchot National Forest in southwestern Washington. The Station and the Western Pine Association also worked with the Madison Laboratory in a nationwide study of maximum temperatures developed in studs and rafters on the sides of houses directly exposed to the sun. Installations were made and measurements taken on two Portland homes by the regional cooperators.

The Douglas Fir Plywood Association and the Madison Laboratory, with the Station's help, continued work on a major project of determining suitability of "white pocket" Douglas-fir for plywood. It is estimated that between 65 and 100 billion board feet of Douglas-fir timber in western Oregon had some stage of white pocket (also called white speck).

As a result of the Wyssen skyline logging operation on the Okanogan National Forest, two Seattle machine manufacturers developed equipment to do a comparable job which was better suited to this country's working conditions. These machines were currently in use on another 8-million-foot sale on the Okanogan National Forest and a 22-million-foot sale on the Mount Baker National Forest.

The Station suffered another severe loss in the death of Elmer E. Matson on October 12, 1958, after a few months' illness. Elmer was widely known and respected among the forest profession and the timber industry for his high professional and personal qualities. He not only preached good forest management but also practiced it on a several-thousand-acre tree farm he acquired, developed, and operated in his spare time.

Later in the year, John B. Grantham, Director of the Oregon Forest Products Laboratory, was selected to fill the vacancy as Chief of Forest Utilization Research.

A highlight of the 1958 work in Range Management Research was the establishment of a comprehensive vegetation game management study of the South Silver Lake deer herd in cooperation with the Oregon State Game Commission.

A preliminary problem analysis of management of big-game ranges in central Washington identified three general problem categories: (1) improvement of big-game habitat management; (2) restoration of productive capacity of deteriorated ranges and increasing the productivity of marginal or low-quality habitat types; and (3) integration of the habitat needs of big game with other important land uses.

Another chemical, cooper amodine, was added to the two tested in an exploratory test the previous year of deer repellents by the Deschutes Research Center, which was cooperating with the Federal Fish and Wildlife Service in an expanded search for ways to reduce deer browsing of ponderosa pine seedlings. It was determined that no significant damage occurred in late spring and summer months. Gophers were also an enemy of the seedlings. Twenty percent of the trees planted were dead after the first growing season. By January 1959, about one-third of the 900 trees in the test were killed or missing in action. Results analyzed in 1958 showed no significant differences between treatments and control at the 5-percent level of probability.

Five years of tests of rotation-deferred and season-long management at three intensities of use at Starkey had accumulated interesting information. Cattle weight gains for the 1958 season differed from the previous 4 years; cow gains were above average whereas calf gains were below average. Rotation-deferred grazing had not shown superiority to season-long for animal weight gains. A remarkable aspect of the study to date was the sustained high weight production of the moderately stocked ranges, regardless of grazing system used.

Studies in the ecology and physiology of range plants continued to feature bitterbrush during 1958 and 1959. A study of its root systems was made in 1958 and 1959. A study was commenced of seasonal trends in available carbohydrates. Studies were also made in 1959 of the effects of gibberellic acid and cold treatment on germination of bitterbrush seed. Bitterbrush showed a remarkable ability to recover the same year it was defoliated by the tent caterpillar.

In 1959, a soil survey of the Starkey Experimental Forest and Range was completed. The information from it provided a basic for better interpretations of soil-vegetation relationships in the Blue Mountain ranges.

In order to take advantage of electronic data processing in analyzing plant community relationships and range survey data, plant nomenclature had to be adapted to fit the system requirements. Accordingly, in 1959 the Range Management Research staff devised alphabetical and numerical codes for names of forest and range plants in Oregon and Washington.

Effects of logging upon soil erosion continued to arouse interest during 1959 in this region. As one of the early steps in the detailed study of logging roads on the Andrews Experimental Forest, a survey was made of the area occupied by roads. It showed slightly more than 6 percent of the total 250-acre experimental drainage was exposed by roads as follows roadbed, 2.0 percent; backslopes, 1.0 percent; fillslopes, 3.2 percent. It was already apparent in 1959 that road construction affected erosion and stream siltation. Preliminary studies indicated that siltation could stem from a small segment of the road and that roadbanks are a potential trouble source. Results of a cooperative study with the BLM and Oregon State College showed that a surprising amount of soil movement occurred as dry ravel during the summer.

Grass had shown ability to protect against frost heaving, dry ravel, and surface water erosion from cut banks. Further study to learn the most effective grass cover was underway during 1958 and 1959 at the Bull Run watershed using different applications of fertilizer. Results here demonstrated the value of fertilization.

Six years of streamflow records from the Andrews Experimental Forest, together with records from other study locations, were used to determine approximate water balance of a typical old-growth Douglas-fir forest. Average annual precipitation was 92 inches, of which 65 percent became streamflow; 12 percent was intercepted by tree crowns before reaching the ground. Evaporation and transpiration accounted for the remaining 23 percent, mostly taken from the soil mantle by vegetation of all kinds.

Several other watershed studies were installed in central Washington, southwestern Oregon, and in eastern Oregon to determine similar information for other major vegetative and climatic zones of the Pacific Northwest. Soil moisture measurements were also undertaken at all of these study locations to learn more about this important factor in forest water management.

Interest in the upper-slope types potential for timber production called attention to need for more information on forest disease problems in timber management of these types. Decay losses were known to be considerable in large poles and sawtimber-size true firs injured in logging. This raised questions concerning the value of advance reproduction. The Forest Disease Research program was revised in 1959 to give immediate attention to this problem and to heart rot of mature trees of these species. A common rule of timber estimators had been to cull true fir trees if one conk *of Echinodontium tinctorium was seen on the* bole. Preliminary *tree dissection studies* indicated that this rule of thumb probably was over-conservative and wasteful of merchantable timber.

Poria weirii was found damaging mixed-conifer stands in the Blue Mountains of northeastern Oregon. It *was* found to occur in all major coniferous types in the Pacific Northwest except pure ponderosa pine and pure western hemlock.

In 1958, antibiotic tests as a control agent for white pine blister rust in the Inland Empire showed Actidione to be effective. Tests on sugar pine in southern Oregon in 1959 demonstrated equal effectiveness.

No major forest insect problems developed during 1959 to interrupt the orderly progress of the research program. Epidemics in 1959 covered the next to lowest acreage for the past 9 years of record as determined by the cooperative survey program. No largescale direct control programs were needed this year. As usual, the old offenders, spruce budworm, balsam woolly aphid, and the fir and pine bark beetles, were the most active. However, a shade was cost on this bright situation with the chance discovery of the European pine shoot moth on a horticultural planting at Bellevue, Washington, a suburb of Seattle. This added another destructive forest insect to the current list of pests. With the cooperation of the Pacific Northwest Forest Pest Action Council, the Station commenced a survey of the distribution of this insect and an appraisal of possible control measures. So far in 1959 it was found in five ornamental tree nurseries in the Puget Sound area. The shoot moth, as feared, was destined to spread and be a major threat to native pines.

The importation of forest insect predators of the balsam woolly aphid was increased during 1959. More than 38,000 insects representing 13 species were imported and colonized in western Oregon and Washington during the midyear. These insects came from Australia, Europe, and the Indian subcontinent. During 1959, Dowden, of the Northeastern Station, spent 6 months in Japan in search of other candidate predators for importation.

Scarcely any defoliation occurred in 1959 from the Pandora moth infestation discovered on central Oregon ponderosa pine in 1958. Larvae apparently suffered heavy mortality during the winter and spring from natural causes. It was also evident that the 1960 moth generation would not be a serious threat.

A cooperative study with the Weyerhaeuser Co. Centralia Forest Research Center found that outbreaks of the Douglas-fir bark beetle are more acute with some kinds of windthrow than others.

Cooperative studies on the spruce weevil with Crown Zellerbach Corp. foresters on their Clatsop Tree Farm continued to show: (1) damage declines as Sitka spruce attains 25 to 30 years old, and (2) attacks by this pest are more frequent and severe on inland-growing spruce.

Costs of forest fire control continue to mount in the Pacific Northwest as area of cutting increases, particularly during periods of adverse weather. Harvesting of mature forests greatly increases fire danger by adding heavy amounts of dead fuel exposed to wind and sun. Rate of cutting in this region in areal terms had doubled in the 8 years (1950-58), reaching about 230,000 acres in the last year. Fire-danger rating continued to be a major study area for the fire research staff during 1959, and constant improvements were being made in methods and devices for fire-weather predictions. These improvements serve both protection and suppression activities of fire control agencies.

Analysis of fire weather and fire occurrence historical records was proving fruitful. For the first time in this region, fire-season severity was determined in terms of fire occurrence anticipated with observed weather. This computed fire occurrence was obtained by means of regression equations expressing for recent years relation between severity of seasonal weather and fire occurrence. Actual occurrence for 1959 showed a continuing rising trend in number of man-caused fires on western Washington National Forests. In contrast, on State and privately protected lands in that area, there appeared to be a continuing swing toward fewer than expected man-caused fires.

By 1959, the staff of the Division of Forest Management Research consisted of 18 professionals. The complexity of forest types and species and the different types of problems considered, efforts of these people were spread thin in a number of places. Cultural measures, regeneration, silvics, and harvesting practices were taking up over four-fifths of the staff's total effort. Tree-improvement studies received 8 percent; forest measurements, 7 percent; and tree and tree seed physiology, 2 percent. Obviously, these three fields of study were seriously lacking in strength through understaffing as well as from shortage of laboratory facilities.

Forest tree-improvement studies were gaining in interest with the expansion of seed orchards; 86 acres were dedicated to Douglas-fir seed orchards in 1959 and more were planned. One of the urgent problems was finding means of preventing contamination from outside sources. Studies were made in 1959 on time and duration of pollen release and receptivity of female flowers on a series of four elevational transects in the Douglas-fir subregion. It was found that pollen released at any one time was nearly all from trees within a 1,700-foot elevational zone, leading to the conclusion that there was an effective barrier to pollination of low-elevation trees by high-elevation sources and vice versa.

Regeneration studies of five conifers important in southwestern Oregon showed differences pertinent to initial seedling establishment. Tests were made in coarse, medium, and finely textured soils. Although relative ranking of the five species—sugar pine, ponderosa pine, incense cedar, grand fir, and Douglas-fir—varied in depth of root penetration between soils, the first two named species consistently showed the most favorable characteristics for successful establishment; i.e., high germination, good survival, rapid root penetration, and early lateral root development.

Patches of ground covered with rotten wood were found to be good planting sites within the spruce-hemlock forests of northwestern Oregon. Observations also indicated that competing brush is usually scarce on rotten wood.

It was found that ground cover vegetation did not increase 7 years after partial cutting of a Douglas-fir 107-year-old stand on site IV land. This raised the possibility of using partial cutting in some situations under careful practices without danger of accelerating brush growth.

Information on commercial and noncommercial thinnings in Douglas-fir and ponderosa pine stands was building up with each successive year of study and tests. Studies had been made in natural and planted stands and in a range of age and site classes in Douglas-fir. Much of the information gathered had been put into practical application by 1959.

A substantial increase in production of plywood from regional softwoods other than Douglas-fir and increase in production of lumber from the secondary species aroused the interest of the industry in stress grades for all species for marketing reasons. This was a difficult problem, illustrated by the persistent difficulty of establishing a standard value for Douglas-fir from different geographical areas. The Madison Laboratory cooperated with the plywood industry in determining that for structural uses, plywood from western hemlock and several of the true firs should be thicker than Douglas-fir plywood to compensate for lower strength and stiffness. However, other complications were developing, and interest in solutions to these problems led to consideration late in 1959 of a comprehensive study of strength values as indicated by specific gravity range in standing timber.

A departure from previous procedure of the Forest Utilization Research division in conducting end-product recovery studies was the selection of sample trees. Study logs were cut from trees of different growth habits. Recovery study procedures were widened to obtain data needed for developing new or modified log grade descriptions. Lumber recovery value for each log was determined on a shipping tally basis, and each log was diagramed to show surface and end characteristics for correlation with end-product value.

During 1959, a major effort was made to modify and adopt electronic data processing procedures for analyzing the mass of data developing from recovery studies. A modified procedure of constructing curves directly from lumber value of individual logs simplified computation and presentation of findings, and also permitted statistical treatment of the data to measure accuracy. Data from past studies were reanalyzed using the new program.

A major problem of the Pacific Northwest pulp industry was how to improve pulps from Douglas-fir wood. The more desirable pulp species were becoming in short supply. Conversely, the supply of Douglas-fir mill residues exceeded demand at this time. Currently, consumption of Douglas-fir in kraft pulp for paperboard, bags, and related paper products amounted to about 1-1/2 million tons, dry weight, of wood annually. The Madison Laboratory, industry, and other research agencies were working to improve the versatility of Douglas-fir by modification of pulping processes, pretreatment of chips, segregation of raw material, or blending with other pulping species.

During 1959, the Division of Forest Economics Research continued the study of timber trends of the Douglas-fir subregion commenced in 1958. Attention was focused on three principal influences affecting future levels of timber output: (1) the amount of land devoted to timber production, (2) the amount of growing stock, and (3) the intensity of forest management. Calculation of the long-run growth potential for the subregion was involved with estimates of prospective yields and allowable cuts during the transition period. The analysis of the data was completed in 1959 and preparation of the final report started.

Two new studies were initiated in 1959 by the division's section of production economics and marketing. One was a survey and analysis of industrial capacity in the Douglas-fir subregion and the other a study of the rate of capital budgeting for forest management.

An analysis of the economic significance of mortality in old-growth Douglas-fir was made in 1959. Two sources of timber products in old-growth stands are (1) live growing stock and (2) accumulated dead material. Changes in live growing stock occur from addition of gross growth and subtraction from cutting operations, catastrophic losses, enphytotic[24] mortality, and decay in live trees. Additions to the accumulated dead material are the sum of enphytotic and catastrophic mortality and subtractions occurs from salvage during logging, decay in dead trees, and separate salvage operations. Enphytotic mortality was estimated to occur at an average rate of 359 board feet of net merchantable material per acre of old-growth Douglas-fir. With roughly 3 million acres of this type remaining in the Douglas-fir region in 1959, about 1 billion board feet was moving each year from the live timber inventory to the accumulated dead material.

An analysis of the small forest-land ownership situation in the Douglas-fir subregion was commenced in 1959. Problems of the small forest-land owner had been discussed in the TRR reports and previous review of the Nation's timber resource. The Chief's Annual Report for 1958 made special note of this problem, which was directed mainly to the East and South.

The forest survey staff completed analysis of the 1958 logging residue study. A most important result was the establishment of a board-foot volume relationship between actual output measured as timber products and drain on the timber resource as measured by forest survey standards for eastern Oregon.

Three new electronic computer programs were completed in 1959 for use in forest inventories. They complement current electronic programs for computing volume and growth and have prospects for use in other fields of research. Gedney, in consultation with Johnson, developed the supplemental programs for the forest survey. With the increasing importance of EDP in computational phases of the forest survey, several members of the staff were acquiring skills in the preparation of data and use of the new procedures and equipment.

By 1959, Region 6 had acquired an IBM 650 computer, and the Station rented time at $29 per hour. Prior to this, this work was done at the IBM Co. service office in Portland at a higher cost.

Several major changes in personnel took place in 1959, particularly affecting the Division of Forest Economics Research. Melvin Metcalf transferred from the Intermountain Station to head the forest survey in midyear 1959 in anticipation of the retirement of Moravets. In July 1959, Floyd L. Moravets requested retirement. He entered the Forest Service in 1922 and joined the Station in 1929 as one of the original members of the forest survey staff. He was largely responsible for the continuing successful operation of that project. Following Baudendistel's death, he assumed the responsibility for heading all activities of the division at sacrifice of personal desires, not being in the best of health at the time.

In June 1959, Dr. John Fedkiw of the faculty of the New York State College of Forestry, Syracuse University, joined the Station staff, heading the production economics projects. In September of that year, Dr. Carl A. Newport transferred from the Pacific Southwest Station, where he was heading an interregional ponderosa pine log grade project, to become Chief, Division of Forest Economics Research at this Station. Other additions to the division staff during this period were Grover Choate, assigned to survey techniques under Pope, and John M. Berger to the inventory section of the forest survey.

Kenneth Krueger joined the Forest Management staff to assist Silen on the genetics studies.

24 A word to roll around on the tongue. It means mortality which occurs more or less normally each year in all forests. Formerly incorrectly called endemic mortality.

For some time, it was apparent that the Station's administrative burdens were falling heavily upon the director and division chiefs at the expense of the research programs. It was evident that improvements could be made through reorganization of the business management and support services. Before this, Kistler, administrative assistant, directed the business management functions under the immediate supervision of the director. The library, biometric, and aerial techniques, and similar general professional functions were also under the supervision of the director with help of committees or delegation to division chiefs. The Division of Station Management was established with the approval of the Washington Office to be headed by a division chief equal in Civil Service rank to the research division chiefs, and it was decided that the position should be filled by a professionally trained person. Robert W. Harris was selected for this position, transferring from the Washington Office back to the Station in October 1959. Joan Gates was transferred from the Bureau of Indian Affairs as secretary of the new division.

In August 1959, the Station was host for the annual meeting of the National Forest Research Advisory Committee on a combined field trip and office sessions. The group, traveling by bus and accompanied by Assistant Chief V. L. Harper and members of his staff and the director and pertinent members of the Station staff, visited three experimental forests, the Oregon Forest Research Centers of Oregon State College and the Station, several timber industry plants and logging operations, and other field points of interest. From time to time, representatives of public and private foresters, forest educators, and timber industry leaders met with the group informally or at luncheons and dinners. Business sessions were conducted in the evenings when national research programs and priority needs were presented to the committee by Harper and his staff. The Station had the opportunity during the other field sessions and informal meetings to acquaint the group and the Washington Office staff with this region's research problems and needs.

Advisory committee members attending were Backman, chairman, Armstrong, Beale, Bercaw, Garratt, Gordon, Heritage, Langdale, Lawrence, Lyman, Partain, Willits, and Wolf. Dr. Carleton Barnes of the Secretary of Agriculture Office also attended. In addition to Harper and Deputy Assistant Chief Jemison, Beal, Brown, Byrne, Hansbrough, Josephson, Parker, Sims, and Storey of the Washington Office research staff attended the field and office meetings.

On March 24, 1959, Secretary of Agriculture Benson submitted to the President of the U.S. Senate and the Speaker of the House Miscellaneous Publication 794, "Program for the National Forests." This was a sequel to "Operation Outdoors," submitted several years earlier, which was concerned with forest recreation problems and requirements. Although this publication was concerned almost entirely with National Forest programs and needs, a few pages briefly outlined Forest Research problems and needs. In the opening paragraphs of the publication, it was stated "that research needs were based in part on the findings of a Departmental Committee on Research Evaluation."

A turning point in the scope and direction of the Forest Service research program occurred in 1960 when Congress for the first time specifically provided funds for a research construction program. This action signaled the intention to give forest research scientists the facilities to employ modem technology and equipment in seeking answers to fundamental and complex problems. It marked a shift in major emphasis from field studies largely empirical in nature to scientific laboratories where the many facets of complex forest problems could be investigated in totality.

In the immediate postwar period, the problem area concept of forest research was developed with emphasis chiefly on research done in the woods or on the forest ranges. It expanded the concept of 11 distinctive geographical forest regions, each having a forest and range experiment station supplemented by several experimental forests or ranges, into some 80 problem areas[25] or research provinces. Each of these provinces or problem areas had a research center or headquarters, and each had one or more experimental forests or ranges. This overall program reached its maturity in the 1950's. This Station had seven research provinces and eight experimental forests and ranges on National Forest land[26] supplemented by four cooperative experimental forests on private lands.

Disregarding the Sellwood Laboratory and some simple laboratory facilities in the basement of the Omark Building, the first scientific laboratory established by the Station was in 1960, located in the outskirts of Olympia, Wash. The primary project housed in this facility was a cooperative animal damage study with the Fish and Wildlife Service and the Washington State Department of Natural Resources. This was a shoestring venture and the Station's initial investment in 1960 was a little over $8,000 squeezed out of program funds to , e t the construction started. Ground was furnished by the State of Washington adjoining the State's forest nursery.[27] Additional funds were anticipated in 1961 to complete and equip this facility. In all, some $40,000 of Station funds were invested in the structure. It not only housed the Olympia Research Center staff but also Fish and Wildlife Service personnel and Washington State Division of Forestry research foresters were quartered there.

This building was designed for expansion later. The architect was A. P. (Benny) Di Benedetto, at that time a staff member of the Division of Engineering, Region 6.

The big step forward in laboratory facilities in 1960, however, was the inclusion of funds by Congress for the construction of a Forest Insect and Disease Laboratory at Corvallis, Oregon, in the fiscal year 1961 appropriations act. The building was located on the campus of Oregon State College on ground leased on a long-term basis to the Federal Government by the Oregon State Board of Higher Education. Strong support for the appropriation of the funds and negotiations for the property came from President A. L. Strand of the college and Dean Walter McCulloch of the School of Forestry. President Strand was anxious to establish a center of research in the plant sciences at Corvallis. At a session of the national Forest Research Advisory Council in Corvallis in 1959, President Strand and Dean McCulloch urged Federal participation in this overall goal. Benny Di Benedetto was the architect for this building. Like the Olympia Laboratory it featured the use of wood as a primary material in construction of scientific laboratories, a departure from the brick, stone, and concrete structures common on college campuses and other research institutional agencies. The first unit consisted of an administrative wing, a forest disease laboratory wing, and a forest insect laboratory wing. The building was designed to accommodate additional units as funds were available. Although the facility was planned primarily for basic research in forest insects, forest diseases, forest tree and tree seed physiology, and other forest genetics studies, it also housed other Station research units located at Corvallis. Obviously, forest research problems are not bounded by State boundaries, and this facility was intended to be the major Forest Service laboratory for research in forest insects and disease problems in the West. At one time, it was named the Western Forest Sciences Laboratory in acknowledgement of this concept.

25 The list included one each in Alaska and Puerto Rico.

26 Later, two were abolished; the John Day and Port-Orford-Cedar Experimental Forests.

27 Later named the L. T. Webster Nursery. L. T. (Mike) Webster, State Forester, and Bert Cole, Director of Department of Natural Resources, were helpful in this effort and were strong supporters of the Station in many other Station programs.

Although construction of the Corvallis laboratory was not scheduled to commence until the spring of 1961, recruitment of staff personnel commenced in 1960 on the strength of increased project funds in the fiscal year 1961 allotments. Dr. Clarence G. (Hank) Thompson transferred to the Station from the Agricultural Research Service to head the work in forest insect diseases. Dr. K. C. Lu transferred from the U.S. Army Chemical Corps, Biological Laboratories, to take charge of soil microbiological research related to forest tree diseases.

In expectation of research construction funds in succeeding years for laboratories at other locations, negotiations were undertaken by the Station to acquire building sites. At Bend, Oregon, an excellent 10-acre site on Awbrey Butte overlooking the town was donated by the city to the Federal Government for an office-laboratory building. Several sites on or adjacent to the Eastern Oregon State College at La Grande were investigated as a location for an office-laboratory and preliminary discussions were held with the college administration. At Wenatchee, Washington, a 5-acre site for a forest soils and hydrology laboratory was selected adjacent to the Tree Fruit Experiment Station of Washington State College. The Wenatchee Chamber of Commerce assisted the Station in acquiring the property from a private owner, and the purchase was practically completed by the year end. For several years, the Mid-Columbia Research Center had been housed at the Tree Fruit Experiment Station through the cooperation of Washington State College.

Increased project funds made available in 1960 permitted enlarging the scope of the investigative program. Research programs were initiated in forest recreation problems and problems developing from putting in practice multiple use policies. In addition, Douglas-fir tree and log grade studies and forest fire research programs were expanded. The latter program was raised to divisional status, and David Bruce was transferred from the Southern Station to head the new division.

The Douglas-fir log grade study, assigned to the Station the preceding year, was not implemented until mid-1960 when fiscal year 1961 funds were allotted. Paul H. Lane was transferred from the Lake States Station to the Division of Forest Utilization Research at this Station in June 1960 to head this project. One of the first studies planned was an investigation of tree and log quality of inland Douglas-fir.

The division continued to carry on end-product recovery studies of logs of various species, grades, and sizes. For example, in 1960 a study of nearly 700 Shasta red fir logs was completed.

On April 1, 1960, the Federal Housing Administration instituted a requirement for grade and species marking on all structural lumber for FHA-insured housing. Primarily this requirement was made to insure quality, but indirectly it placed a greater premium on lumber strength than had previously been the case in residential construction. This intensified competition between species, resulting in a critical reappraisal of design stresses for western woods, including the little-used species such as the hemlocks and true firs. An outgrowth of this situation was the decision by the Forest Service to proceed with the survey of western wood densities planned a year before by the Madison Laboratory for cooperation with the Western experiment stations. It was anticipated that general predictions of the range of strength can be made from the observed range in density for each species since density and strength are correlative. National Forest Administration, other public agencies, and the timber industry also cooperated in this undertaking. Increment cores were obtained from several thousand trees over the Western States. In this region, forest survey crews collected the cores. During 1960, a crew from the Madison Laboratory collected transverse discs taken at several bole heights from several hundred Douglas-fir and white fir trees in the West for another phase of the study.

Refinement of design stresses of lumber was a time-consuming and expensive process by methods current at that time. It was generally agreed that the ideal method would be to evaluate strength of individual pieces of lumber or plywood by a nondestructive test, previously considered out of reach. Recent research gives promise of designing a practical nondestructive method for stress grading within a few years. The Station's Forest Utilization staff commenced a program of analyzing research in this field and promotion of additional study to expedite this objective.

The wood-laminating industry continued to expand in the Douglas-fir subregion. During 1960, a commercial standard under the Department of Commerce commodity series was drafted. Late in 1960, the Madison Laboratory began a study in cooperation with the U.S. Bureau of Ships to determine the ability of Douglas-fir laminates to withstand fatigue. Harold Worth of the division staff cooperated on this study.

Portland's new Memorial Coliseum, often dubbed the Glass Palace by newspapermen, officially opened in November 1960. Laminated Douglas-fir mullions were used to support the glass walls. The Division of Forest Utilization Research added it to the list of structures being observed for performance in use of laminated structural members.

Final measurements were taken in May 1960 of the 3-year periodic check of moisture content and dimensions of framing lumber in the three ranger district dwellings on the Gifford Pinchot National Forest. The data were sent to the Madison Laboratory for analysis with similar data taken in other parts of the country to predict effect of initial moisture content of framing lumber on subsequent performance in housing.

A slump in the construction market demand for lumber and plywood, commencing in the late fifties, generated economic problems which became acute in the timber industries of the Pacific Northwest during 1960. This condition prompted efforts by the timber industry to economize in all phases of their operations. Marginal plants and operations were discontinued, work weeks were shortened, and seasonal shutdowns were lengthened. Logging costs were carefully scrutinized and cheaper sources of raw material were sought. Long-term investments in tree growing were critically evaluated. Each capital asset was made the object of input-output analysis.

The staff of the production and marketing section of the Division of Forest Economics, aware of these problems, shaped their studies for analysis and possible solution to such problems.

The concept of forest management as a problem in investment capital management was presented in "Capital Budgeting for Acquisition and Development of Timberlands," by Fedkiw in Yale University Bulletin 66, "Financial Management of Large Forest Ownerships." Fedkiw advanced the basic premise that forest enterprise for wood production was primarily an investment type of enterprise. He outlined a theory and method for forest management planning, using appropriate methods of economic analysis. He integrated the strategic value of a long-term wood supply to protect investments in plant and equipment into that concept of forest management, placing emphasis on rate of return as a primary criterion.

An analysis of industrial capacity of the Douglas-fir timber industry was made by the division. In terms of log production, the plant capacity of this subregion reached its most dramatic height during the postwar decade, 1947-56. The softwood plywood capacity quadrupled and pulp capacity doubled during that decade. On the other hand, sawmill plant capacity increased by a third from 1946 to 1952 and then reversed itself, almost reaching its prewar level by 1959. The industry also shifted from western Washington southward as new capacity was concentrated in southwestern Oregon, attracted by this area's reservoir of unexploited timber resource.

The office report of the timber trends study of the Douglas-fir subregion was completed during 1960 and in-Service review was underway. One conclusion reached was that trend southward of the center of the industry would eventually reverse itself and move northward where large second-growth stands predominate.

A cooperative study of the economics of “clean” (single stage) logging compared to prelogging (two-stage yarding of clearcuts) was undertaken during the year on the Clemons Tree Farm with the Weyerhaeuser Timber Co. The stand under study was 100-year-old “mature” hemlock. Another cooperative study with this company and the University of Washington, commenced during the year, was the economy of advance roading in second-growth timber.

Another cooperative study of improved methods for public timber appraisal was begun in 1960. This study, with the University of California, was planned to determine, as a first step, the nature and degree of competition in the Douglas-fir lumber industry and the trend in competitive conditions.

A study of the economics of multiple use management, practically an untouched subject, was undertaken in 1960. Wesley Rickard, formerly on the forestry staff of the Weyerhaeuser Co., was recruited to conduct this study, with the object of establishing guidelines for decisionmaking where two or more uses appear possible on a given forest-land unit.

The forest survey, the division workhorse, continued to supply up-to-date information on the region’s forest resource from the reinventory program.

Staff of the Division of Forest Insect Research devoted considerable time during 1960 to working with

Di Benedetto on plans for the insect wing of the Corvallis laboratory and investigating and selecting laboratory equipment. Recruitment of personnel for the laboratory was another priority task.

Late in the year, it was decided within the Service to consolidate pest detection, pest evaluation, and pest control activities within the Timber Management Division of the Regional Office to take effect July 1, 1961. This relieved the Station of responsibility for forest insect and disease surveys. Although there was some loss of funds and personnel involved, it freed the division chief and principal assistants from supervisory activities and increased time available for research functions.

Prospects of modern laboratory facilities insured, planning for a strong program of research in natural control of forest insects moved ahead rapidly. C. M. Thomas returned from Berkeley, California, to assist Dr. Thompson in studies of insect diseases. Pending construction of the laboratory, temporary quarters were provided by the college’s entomology department, suitable at this preparatory stage in reviewing research needs and developing procedures and techniques.

Surveys of the European pine shoot moth had shown it spreading on ornamental pines in many places in Washington and to the vicinity of Portland. Threat to native pines mounted and no practical method of control was known. Fumigation with methyl bromide gave the most promise and a series of tests were planned in cooperation with the Washington Department of Natural Resources, the ARS, and a number of private property owners. The first tests were made late in the year to develop methodology.

Release of foreign insect predators of the balsam woolly aphid continued for the fourth consecutive year; 19 predator species had been introduced by 1960. Several more years were required to determine if the releases in the forests would succeed in establishing natural control.

During 1960, preliminary studies were made of an unidentified pine needle miner attacking extensively in southern Oregon pine forests.

The cooperative study, started in 1959 with Weyerhaeuser Timber Co., of factors affecting attack and brood production of the Douglas-fir bark beetle in blowdown timber was completed. A long-term study by Station entomologists and pathologists of the deterioration of trees killed by the bark beetle in 1951 and 1952 was nearing completion. After the final examination in 1963, a detailed report would be prepared for the entire study of this destructive insect.

During 1960, the Division of Forest Disease Research intensified studies of a number of aspects of dwarfmistletoe in ponderosa pine forests of the Pacific Northwest. This pest was present on over a million acres of ponderosa pine throughout the region. Dwarfmistletoe biology was a complex and largely unexplored field of study at that time. However, it was known that it could be controlled by cutting. Research was needed to detect critical points in the life cycle to develop efficient control methods. Economic problems as well as biological problems required solution before control measures could be applied effectively. Measurement of the growth impact of this disease was undertaken as a basis for economic analysis of control by sanitation cutting.

A program of research on soil microbiology in relation to forest tree root diseases was being developed by Dr. Lu during 1960 who was temporarily quartered with the college soil microbiologists at Corvallis.

A 50-percent increase in the Forest Fire Research staff plus the part-time services of weather forecaster Bob Lynott made possible a broader and more effective attack on pressing problems besetting the fire control organizations. There had been constant pressure over the years for strengthening this field of research in the Pacific Northwest.

Preliminary analysis in 1960 of previous years' observations of 50 slash disposal fires pointed to fuel moisture as the most important single factor controlling behavior.

Recognizing the importance of improving fire-weather forecasts, the U.S. Weather Bureau and the Forest Service prepared a "National Plan for Fire-Weather Service." This plan outlined a program for fire-weather service and provided for future expansion and intensification over the succeeding several years. Cramer contributed considerable technical material to the plan.

Wind is the dominant single weather factor in spread of fires. Variations of local winds in mountainous terrain were baffling forecasters. Current procedures for forecasting mountain winds weren't doing the job. During a study in the Oregon Coast Ranges, an alternative procedure to the unsatisfactory current methods of wind analysis showed promise of solving the problem. This was called the terrain-surface potential temperature map, which was an analysis of surface air regardless of elevation instead of a horizontal pressure analysis tried in the past. Potential temperature, which was closely related to vertical motion, was readily computed from surface temperature reports, and plotted on a topographic map made possible analysis of both thermal and mechanical influences of terrain.

Substantial progress in the study of the upper-slope types was made during 1960 by the Forest Management staff at Corvallis. Franklin showed a special interest in this new project. A literature review was completed and a preliminary program drafted. In the beginning, studies were concentrated on the ecology of the true firs and mountain hemlock. The upper-slope types cover over 2 million acres in the Pacific Northwest, and contain some 80 billion board feet of sawtimber size.

Results of a new study of the 30-year-old planting of Douglas-fir and red alder at the Wind River Experimental Forest showed that red alder greatly helped restore nitrogen and organic mater to fire-depleted soils.

A study of seedfall from a 50-year-old Douglas-fir stand at the Voight Creek Experimental Forest showed that all thinned stands produced some 15 to 16 pounds of seed per acre compared to only 8 pounds in an adjacent unthinned stand of the same age.

The performance of wildling Sitka spruce seedlings compared to 3-0 nursery grown stock was studied at Cascade Head Experimental Forest starting in 1958. At that time, the wildling stock was twice as large as the nursery stock. In 1960, after three growing seasons, the wildling seedlings had higher survival rate and also increased their initial height advantage. Wildling stock can be found growing profusely in small openings or along roadbanks in many places in the coastal spruce-hemlock area.

Contrasting regeneration studies of mycorrhizal fungi were being conducted in the laboratory by Trappe. He was growing isolates of *Cenococcum graniforme* from several widely differing habitats in pure culture at room temperature. This fungus was selected as a candidate for use in forest tree nurseries to improve survival of stock planted on severe sites. It was known to form mycorrhizae on many conifers widely distributed geographically.

A source of unsuspected seedling damage by grubs of rain beetles *(Pleocoma* spp.) was found in southwestern Oregon. When 1-year seedlings were lifted from heavy clay loam soil, tap roots of four conifers had been severed by this grub.

Control of salmonberry by foliage sprays had proved effective for only 2 or 3 years, so basal sprays were tried; first trials showed them to be more effective in eradicating this brush.

Study was commenced in 1960 of the shelterwood system of final harvest in coastal forests at Cascade Head and Hemlock Experimental Forests.

A radio-controlled skyline crane was installed at Cascade Head through cooperation of Publishers Paper Co. and Skagit Iron Works to study suitability of this equipment for harvest cutting of spruce-hemlock 100-year-old stands on steep slopes.

Analysis of 10 years of record of growth and yield of the Snow Creek plantation on the Olympic National Forest demonstrated high productivity, particularly when light commercial thinnings were started at an early age. Total yields in cubic feet of this plantation at age 36 were 65 percent above “normal” values for the same age and site (site III in this case).

The professional Forest Management staff in 1960 numbered 20, and 8 of the number were enrolled as part- or full-time students working on doctorate programs. Although this slowed progress in current projects, it promised *a* future staff trained in specialized fields needed to find fundamental answers to many unsolved problems in plant physiology, ecology, genetics, soils, and silviculture.

The Division of Watershed Management Research constructed stream gages in four additional small watersheds, two in the Entiat River drainage in the Wenatchee area and two in the South Umpqua Experimental Forest. A large part of the effort expended in watershed management studies since the program was established a few years previously had to be devoted to installation and calibration of facilities such as the above. That was the best known method of measuring and recording the effects on streamflow of a wide range of types of forest cover, soil, and precipitation found in the Pacific Northwest.

The “oldest” watershed installation, on Lookout Creek in the Andrews Experimental Forest, was beginning to produce results. Plans were made to log one of the experimental watersheds by some form of a gravity-skyline system as a basis of comparing it with the standard high-lead system. A soil vegetation survey of the three Lookout Creek study watersheds was completed in 1960 to determine relative capabilities for soil moisture storage and influences on streamflow.

Use of the small experimental watershed method to determine various forest treatments on erosion demands reliable methods of measuring suspended sediment in streamflow. Existing methods lacked scientific reliability. To overcome this deficiency, a battery-operated device was designed to collect sediment samples at any given time interval at the weir overflow.

As a start in the investigation of soil erosion hazard at the Wenatchee Center, a study was commenced to determine the influence of environment on relative susceptibility of various soils to erosion.

Work of the Division of Range Management Research was undergoing redirection and expansion in 1960. Wild land recreation research was added to the Station's responsibilities and assigned to that division. Wiley Wenger, who received a master of science degree in June 1960 from the New York State College of Forestry at Syracuse, joined the staff in July to conduct studies in this new field. Prior to graduate study, Wenger had been in National Forest Administration, Region 6, and had developed a special interest in forest recreation.

Studies in management of big-game ranges were directed toward more fundamental studies of plant growth processes. Added attention was given in 1960 to the environmental and chemical aspects of bitterbrush production on key game ranges in eastern Washington. The plant survey phase of a comprehensive study of vegetation-game management on the South Silver Lake deer herd range was completed in cooperation with the Oregon State Game Commission. This permitted giving emphasis to more basic studies of plant-animal relationships in developing effective management practices of wildlife habitat in southeastern Oregon.

Use of forage on the Starkey Experimental Range by deer and elk had increased steadily since 1957, reaching the second highest use in 1960 since records were first kept in 1953. During 1960, these game animals used over half as much forage as that used by cattle during the 4-month grazing season.

Greater attention was given to the basic soil-plant relationships in the long-term studies of livestock grazing on the Starkey. Although much remained to be learned at this stage of the comparison of deferred-rotation and season-long grazing on the experimental pastures, some benefits of the project were already gained. A number of show-me trips were being conducted for range technicians, stockmen, and rangeland administrators. At the time the study started, only two National Forest range allotments were under deferred-rotation grazing, one on the Malheur Forest and the Starkey range on the Whitman Forest. By 1960, an increasing number of allotments in Region 6 had shifted from the old practice of season-long grazing. Led by Harris and Garrison, the Starkey staff had worked closely with Avon Denham, assistant regional forester in charge of Range and Game Management of Region 6, to spread the gospel.

During 1960, "Key to Important Woody Plants of Eastern Oregon and Washington," U.S.D.A. Handbook 148, by Doris W. Hayes (of the Washington Office) and George KA. Garrison, was published.

In planning the recreation research program, two phases of the problem were recognized: (1) the wild-land resources useful for recreation, and (2) the users, the characteristics, attitudes, and preferences of the recreationists. These two factors were dynamically related. It was decided to study wilderness recreation first, owing to the mounting public interest, the ecological fragility of wilderness, and the general scarcity of sound information on wilderness use. The Outdoor Recreation Resources Review Commission nationwide study was underway at the time, but their findings were not scheduled for release until late 1961.

In the past, the section of aerial survey techniques research, as indicated by the name, had been limited to aerial survey methods. However, in 1960 the program was expanded to include other aspects of forest inventory and mensuration.

For example, national forest survey standards were requiring area statistics based on a 1-acre minimum. Faced with the inadequacy of the 1/5-acre plot currently used, several patterns of point samples were systematically distributed over the acre. Each pattern was evaluated as a basis for estimating both area and volume.

Work on forest insect surveys was largely concentrated during 1960 on preparing reports on current studies and preparing a problem analysis for future work.

The biometrics research section, in addition to routine work, prepared an electronic computer program for stumpage appraisals, a description of the volume-weight ratio, sample scaling method for timber sales, and a formula for the standard error of estimated timber volume from cruise data under point sampling.

October 31, 1960, Erna J. Jeppeson, Station librarian, GS-9, retired. Erna joined the Station as a clerk in 1935. Although performing librarian duties for a number of years, she was not officially classified as a librarian until January 1949. She was replaced by Marie Gould[28] who had formerly been the Department librarian in Portland.

Station allotment of funds from fiscal year 1961 (July 1, 1960, to June 30, 1961) appropriations exceeded a million dollars, for the first time thus joining the millionaire's club of six member Stations, excluding the Forest Products Laboratory. Of the nine regional experiment stations (excluding Alaska and the Tropical "stations"), only three were in the "poor relation:" class prior to this time. The other two were the North Central and Central Stations. This Station's total appropriation for F.Y. 1961 was $1,381,000, of which $350,000 was for maintenance and construction. Another increase was granted for fiscal year 1962 which totaled $1,735,000, of which $285,000 was earmarked for construction. The construction funds for F.Y. 1962 were allotted for a soils and water office-laboratory at Wenatchee, Wash. (later named the Forest Hydrology Laboratory) and a silviculture office-laboratory at Bend, Oregon. Construction of the initial unit of the Olympia Laboratory was completed late in 1960, and it was occupied by the animal damage research personnel at the beginning of 1961. The total cost of this laboratory, when completed and equipped in 1961, was about $40,000, all of it drawn from savings in program funds, principally the Division of Forest Management Research. All of the staff of the Olympia Center moved to this location. A trailer was purchased to house overflow personnel.

The structure and program of the Forest Management Division was modified during 1961 from the research center form to a project form to strengthen and concentrate efforts on the most urgent forest management problems of the region. Of the nine selected projects, five were directed to improving silvicultural practices for the following major forest types: (1) Douglas-fir, (2) spruce-hemlock, (3) mixed conifers of southwestern Oregon, (4) eastside forests of ponderosa and lodgepole pines, and (5) true fir-mountain hemlock forests of the Cascade and Coast[29] Ranges. The remaining four projects were aimed at solving critical problems common to several forest types: (6) seeding and planting, (7) forest-tree improvement (genetics), (8) brush control, and (9) animal damage control.

A plant physiologist, Dr. M. A. Radwan, was added to the cooperative animal damage project in mid-1961 A three-room laboratory was equipped for biochemical and radiochemical research. The program planned included (1) physiological response of trees to various kinds of animal damage, (2) biochemical animal attractants in plants, and (3) development of direct and indirect methods of damage control.

28 Miss Gould was with the ARS in Peoria, Ill., immediately before joining the Station October 2, 1960. She suffered a reduction in grade from GS-111 to GS-9 to come to Portland, the city of her choice.

29 Includes the Olympic and Siskiyou Mountains. Mountain hemlock was not a component of the stands in the Coast Ranges.

The provenance study of Douglas-fir, nearly half a century old in 1961, continued to yield valuable information on planting stock and seed source relationships. Each year new findings were added. For example, it was found that seed origin is more critical at plantings about 2,000 feet in elevation than at lower elevation sites. It was also discovered that mortality from the historic November 1955 "deep freeze" was related to the individual parent, and that slenderness or stockiness of progeny was commonly associated on all plantations with the individual female parent.

Dense stands of varnishleaf ceanothus often develop after clearcutting and slash burning in southwestern Oregon old-growth forests. Since parent ceanothus plants were rarely present in the understory of the uncut stand, subsequent appearance of this brush mystified foresters. Studies of the Roseburg staff (Gratkowski) showed that viable ceanothus seed produced in earlier tree generations had been dormant in the surface soil two centuries or longer. It was also learned that heat from broadcast slash fires break the dormancy of this seed.

Five experimental patterns of clearcutting in old-growth Douglas-fir were applied on the Andrews Forest during 1955-56—east-west and north-south strips of several widths, small group cuttings (1/4 acre to 4 acres), seed-tree cutting 20 acres in area, and conventional staggered settings 40 acres in size. After 5 years, all four of the modified patterns were found to be better stocked with natural regeneration than the conventional staggered setting system.

A thinning in a 67-year-old Douglas-fir stand on the McCleary Experimental Forest disclosed the importance of tree size on value yields from commercial thinnings. Total tree value, f.o.b. mill, ranged from $1.60 for trees of 10 inches d.b.h. to $73.35 for 30-inch trees, the largest class. When both volume and value increment was considered, increased returns from growing trees to a diameter of 22 to 24 inches appeared substantial.

A check of damage from a heavy, wet snowfall in November 1960, made on the Voight Creek Experimental Forest, showed damage heavier in the unthinned than in the thinned compartments.

Cost of scaling all logs from a harvesting operation can be excessive in some cases, particularly in relation of total value of cut timber. A recent study at Cascade Head pointed to substantial savings from sample scale. Comparing savings from sample scaling costs to maximum possible gain or loss from sampling area amply justified the sampling procedure.

Measurements of soil moisture in thinned lodgepole pine stands on pumice soils in central Oregon were made at intervals through the growing season with a neutron probe, furnished through cooperation of Oregon State University.[30] Comparison of data from light and heavy thinnings showed greatest reduction of soil moisture occurred in the lightly thinned stands.

Response of ponderosa pine saplings to release from overstory and thinning was prompt and dramatic, indicated by records of a spacing study at Pringle Falls.

In the middle of 1961, staff of the new true fir-mountain hemlock project was increased from one to two scientists with assignment of Williams and Franklin to it. Initial studies were of regeneration problems emphasizing three species, Pacific silver fir, noble fir, and mountain hemlock.

30 March 6, 1961, Oregon State College attained university ranking officially.

Large quantities of unburned logging slash were accumulating on numerous small cutting areas, creating a major fire hazard to surrounding green timber. In a move to promote safe and effective methods for burning these areas, the forest fire research staff tested two electrical instruments to determine their usefulness for slash burning. An electric wood-moisture meter was tested to measure dryness of slash directly, but several difficulties were found in use of the instrument in practice. As a result, the half-inch, wood, indicator sticks were reexamined and found useful if stick-moisture criteria were varied to fit certain easily identified physical conditions.

The other instrument tested measured temperature of distant flames in hope of finding a practical method of measuring fire intensity. Again, inherent limitations in the instrument discouraged its use in rating slash fire intensity.

The Cascade fire-weather project was proposed to develop information on the occurrence and cause of weather variations in the Cascade Range for use of forecasters and fire control people. This was a cooperative project with Federal and State fire control agencies and the U.S. Weather Bureau. In 1961, the Station began preliminary studies to explore procedures using all available data from a few selected weather stations in the Cascades.

Ground was broken for the Corvallis laboratory on May 8, 1961, with President Strand of Oregon State University turning the first spadeful. Completion of the laboratory was scheduled for the spring of 1962.

In anticipation of opportunities for expanding basic research, two more research forest entomologists were added to the permanent staff; Dr. Roger Ryan[31] on May 29, 1961, and Fred H. Schmidt on December 11, 1961. This provided initial staffing for the three major subjects of forest insect research to be undertaken at the laboratory: (1) diseases, (2) biological control, and (3) physiology, nutrition, and behavior.

The cooperative crash program to control the European pine shoot moth produced a method of fumigating with methyl bromide that appeared to be successful in eradicating this pest in ornamental tree nurseries and on individual ornamental plantings of pine. Optimum combinations of time and temperature were developed which would give 100-percent control without causing tree damage. This was a particularly sensitive problem, as tolerance varied between the species of pine. It was hoped that if a successful fumigating and quarantine program could be established in ornamental tree nurseries and plantings, the spread of this destructive insect to native stands of pine could be prevented.

The cooperative program of controlling the balsam woolly aphid by introducing natural predacious insects from abroad was in its fifth year in 1961. Some moderate successes in establishing colonies of some predators encouraged continuation. One imported predator, the beetle *Laricobius erichsonii*, was proving most effective in reducing aphid populations. In a cooperative study with Oregon State University, a method was developed for mass rearing an insect parasite of the Douglas-fir bark beetle. Its effectiveness was limited by the thick bark on old-growth trees; however, it was thought to have future prospects in the thinner barked second-growth Douglas-fir managed stands.

Progress was already being made in forest insect disease studies. Dr. Thompson, working in the Oregon State University laboratories, developed an improved bioassay method for evaluating insecticidal activity of *Bacillus thuringiensis,* a recently developed commercial biological insecticide. A virus disease of spruce budworm, discovered in 1960 in southcentral Oregon, was determined to be caused by a granular virus by laboratory examination in 1960, a significant find.

31 Dr. Ryan received his doctorate from Oregon State University in 1961. Prior to receiving a permanent appointment, he had been employed by the Station as a biological aid.

Natural controls of plant diseases had been studied for some time in agricultural research but were relatively new in forest tree disease studies. Laboratory studies by the Station had shown that two *Streptomyces* isolates from forest soil greatly inhibited growth of a damaging root pathogen, *Phytophthora cinnamomi.* It was planned to expand studies in natural control when the Corvallis laboratory was equipped and fully staffed. Dr. K. C. Lu was the only staff member engaged in such work in 1961.

Two antibiotics, proved effective against white pine blister rust, were tested on *Elytroderma* needle cast of ponderosa pine without success. It was thought other antibiotics might include one that would be of practical value in control of this disease.

Organization of the Watershed Management Research programs was regrouped in 1961, concentrating the staff at two locations to take advantage of the laboratory facilities under construction at Corvallis and in the planning stage at Wenatchee.

The division's technical staff was increased to eight by the assignment of C. T. (Ted) Dyrness, a soil scientist, to he Corvallis staff and the recruitment of Dr. William Fowler, a meteorologist, December 1961, and Dr. William Lopushinsky, a plant physiologist (scheduled to report in 1962), to the Wenatchee staff.

Planning of the Wenatchee facility, for which research construction funds were allotted in midyear, occupied much of Dunford's time. A Spokane firm[32] was awarded the contract for architectural work at Wenatchee.

Although this division was giving increasing attention to basic research in program planning and recruitment of personnel, applied research still formed the major part of the program. Progress in obtaining application of improved watershed practices in management of public and private forest lands still depended upon results of current field studies in forest cover and streamflow relationships and in erosion and sedimentation.

Experimental watersheds on the Andrews Experimental Forest on the west side and on the Entiat experimental watershed installations on the east side were producing information on what happens to water and soil when timber is cut and roads are constructed. Measurements on the Entiat indicated that small lower tributaries of drainages on the east side of the Cascades may provide a larger portion of total water yield than previously considered. The large diurnal fluctuations in streamflow, occurring in summer months through consumptive use by riparian vegetation, was being studied. Water for agricultural use was a vital resource in the orchard economy of this area.

In order to explain changes in streamflow when vegetative cover in a watershed was altered, greater attention was being given to learning more about the principal elements of the hydrologic cycle. A number of studies were underway or planned to fill in deficiencies in this store of knowledge.

Studies in soil erosion control on the Andrews Forest and on Mission Creek near Wenatchee were yielding some results for early application.

The highly erodible Swauk sandstone soils of Mission Creek were found to be losing soil at the rate of 1.5 to 2.0 tons per acre annually, based upon 4 years of measurement. Development of an adequate vegetative cover on these spots through application of high potency chemical fertilizers promised to be a good method of control for critical watershed areas.

32 Di Benedetto, on the Regional Office staff, prepared the design for the Wenatchee laboratory. However, owing to his commitment for completion of plans and bid award for the Corvallis laboratory and commencing plans for the Bend Silviculture Laboratory, the firm of Walker, McGough, and Foltz were retained to prepare plans and specifications.

On the Andrews Forest, studies had shown the value of vegetative cover in stabilizing steep roadbanks.

Following the increasing trend towards fundamental studies, the Division of Range Management Research oriented its program toward learning more about environmental factors in relation to livestock, wildlife, and the user—people.

The cooperative game management study program in Oregon emphasized more detailed measurements of game forage in relation to deer population and migratory habits.

Classification and description of the vegetation types in the Silver Lake deer herd area was completed. Oregon State Game Commission personnel collected rumen samples from 20 mule deer to learn their foraging habits and food preference. With this information, the Station arranged in tabular form the major food species, by vegetation type of the rumen samples by percent of total volume and frequency. This demonstrated the need for management of a deer herd and its habitat on an ecological basis.

Prior to 1961, big-game habitat studies had been concerned with mule deer and Rocky Mountain elk ranges on the east side. Increased funding permitted attention to studies of Columbian black-tailed deer and Roosevelt elk habitat problems on the west side of the Cascade Range.

Spacing, growth increment, and forage production studies in eastern Washington demonstrated that thinnings of overstocked stands of ponderosa pine reproduction greatly increased both timber and forage yields.

A study of habitat requirements of antelope bitterbrush showed that occurrence of this important game forage species in the central Oregon juniper zone was closely associated with distinctive soil and topographic conditions.

Classification of vegetational, soil, and topographic components of nine ecosystems in the central Oregon juniper zone was completed in 1961, based upon ecological units relatively undisturbed by man or foraging animals.

Principal 1961 activity of Wenger in launching a recreation research program was to develop and evaluate a plan for gathering basic back-country wilderness-use data. In order to define what “wilderness” meant to the user public, unmanned registration stations were installed at strategic points in two wilderness-type areas of the region. In all, 52 stations were located at trail heads into the wilderness areas. The overall objective of the study was to define that concept in meaningful terms for public forest-land managers.

In response to the realization of the importance of the economic aspects of wild-land resource management and in the decisionmaking function by land managers, Forest Economics Research expanded in scope and intensity at the Station. By 1961, there were 18 professional staff personnel in Forest Economics Research at the Station. Eight of these people had advance degrees in economics, including six doctorates. Of the remaining staff, five had advance degrees in forestry. Others of the staff were in various stages of graduate work.

The timber trends study of the Douglas-fir subregion was in the process of completion and preparation of a report for publication. A comprehensive study of the eastern Oregon forest resource and timber industry was also being prepared for publication.

Basic data for many of the economic studies continued to depend upon progress of the forest survey in keeping forest resource data current. This project was now moving ahead more rapidly, and during 1961 about 5.5 million acres of commercial forest land were reinventoried in Oregon. Continued emphasis upon survey techniques research was making possible economies of efforts and improvement in reliability of an enlarged scope of data.

In cooperation with the Bonneville Power Administration, a 2-year project was started in 1961 to forecast by 5-year periods from 1965 to 1980 production and employment in logging, lumber, plywood, fiber, and chemical segments of the timber products industry of the States of Idaho, Oregon, Washington, and Montana west of the Continental Divide. This information was needed by BPA in evaluating future power requirements of the Columbia Basin area.

Other economic studies underway or started during 1961 included: (1) the economy of advance roading in second-growth timber, (2) cost of ponderosa pine dwarfmistletoe control, and (3) analysis of forest management intensities.

Log exports to Japan were becoming the object of criticism by some timber industry people. Log exports nearly doubled in volume during 1961 compared to 1960 exports. On the other hand, exports of lumber increased at a slightly higher rate. Volume of both logs and lumber exports to Japan were still considerably less than in the 1930's prior to World War II. However, current exports were concentrated near a few seaport areas and were putting upward pressure on log prices. The Station was asked to report on the rate of log and lumber exports and to examine effects on the regional economy.

Station economic research was producing some significant information on changing relationships between plywood and lumber industries of the Douglas-fir subregion and structure of the Douglas-fir lumber industry.

For example, capacity of the lumber industry reached a peak of 11.9 billion board feet of lumber output a year in 1951, or 10.2 billion board feet log scale. Plywood capacity that year was 3.6 billion square feet, 3/8-inch basis, or 1.6 billion feet log scale. Total log input for the two industries combined was 11.8 billion board feet log scale. Since that year, the combined capacity of the two remained stable, but the lumber capacity declined in every part of the subregion. Plywood, on the other hand, increased its share of combined capacity from 13 percent in 1951 to 30 - percent in 1959, based upon log input. During this time, there was a pronounced trend towards integration of the two industries.

Merger activity in the lumber industry proceeded rapidly during the 1950's, surpassing all other manufacturing industries in the United States. Of the 20 largest lumber producers, 8 disappeared through mergers, 3 went out of business, and 1 became a cooperative. Despite these trends, there remained a high degree of competition in the industry nationally compared to other industries in the building construction field. In terms of value of products shipped, the four largest lumber firms accounted for only 6 percent of the total.

The Divisions of Forest Economics and Forest Utilization Research were working jointly on two projects: the western wood density survey and engineering and economic aspects of aerial logging systems. In 1961, the latter was concerned mainly with skyline systems, one at Cascade Head Experimental Forest and the other on the Andrews Experimental Forest. Early in 1961, Virgil Binkley, a graduate of the University of Washington and a military-trained helicopter pilot, joined the Station's Economics Research staff. At the time, he was completing graduate study at the university. He was headquartered at Seattle, working on aerial engineering studies for a short time before moving to Portland. The Station was exploring possibilities of helicopter logging in concert with Bill Nelson of the Washington Office and possible cooperative studies with Boeing and Sikorsky plane manufacturing companies.

The western wood density survey got a tremendous boost early in 1961 through a contribution of $300,000 by the West Coast Lumbermen's Association, the Western Pine Association, and the Douglas Fir Plywood Association. Additional help came from State and other Federal agencies.

Phase 1, collection of increment cores, was about half completed by the end of the year.

As a step in preparing for an intensive study of helicopter logging in the Pacific Northwest and Alaska, the Station, working through the Division of Forest Utilization Research, entered into a cooperative agreement with Oregon State University for a preliminary analysis of the potential for this innovation in logging systems. An exploratory study attracted attention to the high potential for this type of logging in southeast coastal Alaska and similar country where topographic problems discourage conventional logging methods.

The Douglas-fir section of the national log grade project was initiated by an interregional study of inland Douglas-fir in 1961. The objective of this study was to develop standards for grading sawlogs and standing trees throughout the inland commercial range of this species. John W. Henley and Eldon Estep joined the staff of this project early in 1961. At the same time, the lumber and plywood grade recovery program of the FUR Division was continuing under Doug Hunt's supervision to provide data for improving the currency and uniformity of National Forest timber appraisals.

Other studies of the division in wood product serviceability included the exploration of means for nondestructive evaluation of strength properties and the performance of wood in use. During 1961, the division developed a comprehensive plan for studies covering performance of wood products for a number of uses under typical Pacific Northwest environmental situations. To facilitate this program, the Station arranged for a 10-acre new product test site for the Madison Laboratory adjacent to the Station's new Olympia laboratory. The property was leased from the State of Washington and the site was prepared and maintained by the State's Department of Natural Resources under a cooperative agreement. The installation was one of four which would simultaneously expose specimens of a variety of wood products to four climatic extremes. The other three were located at Madison, Wisconsin, Gulfport, Mississippi, and Fresno, California.

By 1962, reorganization of the structure of the Station's entire research program had been completed and the Pacific Northwest was assigned 39 projects. This action was part of a nationwide effort to give greater emphasis to solving major identifiable research problems and less emphasis to functional fields of research.

Of this Station's 39 projects, 19 were headquartered in Portland, 1 in Bend, 9 in Corvallis, 2 in La Grande, 2 in Roseburg, 2 in Olympia, 1 in Wenatchee, and 3 in Seattle. Actually, all of these 39 projects were not fully activated at this time, and change was to remain the name of the game for some time to come.

Although increased program funds were comparatively small for fiscal year 1963, an exception was the allotment of funds to establish a program of forest engineering research in the Pacific Northwest. The first study was designed to determine the feasibility of helicopter logging. For a year or more, work had been underway as a preliminary step. In 1961, under a cooperative agreement with Oregon State University, Professor John O'Leary, associate professor of logging engineering, had commenced exploratory studies in the Pacific Northwest and Alaska. In November 1962, Hilton Lysons was added to the Station's permanent professional staff to head the forest engineering project, initially assigned to the Division of Forest Utilization Research.

Progress in development of research facilities was a notable feature of 1962. In early summer, contracts for construction of the Forest Hydrology Laboratory at Wenatchee, Washington, and a Silviculture Laboratory at Bend, Oregon, were awarded, and by year's end work was well underway.

Funds were obtained from the accelerated Public Works Program for construction of greenhouses and site improvement at Roseburg, Oregon, and Wenatchee. Plans were made and contracts were awarded early in 1963.

The Forest Sciences Laboratory at Corvallis, Oregon, was dedicated in August 1962, and the building was occupied and operating well throughout the last half of the year.

The seeding, planting, and nursery project of the Division of Forest Management Research was increased from two to three scientists with the addition of Dr. Kenneth Krueger, who with Trappe was stationed at the new Corvallis laboratory. The project leader, Stein, was headquartered at Portland. The silviculture project of true fir-mountain hemlock and Sitka spruce-western hemlock types was located at the Corvallis laboratory, headed by Ruth. Other staff members were Franklin, Williams, and Yerkes.

Excellent opportunities were offered for solving regeneration problems through a team approach, since staff specialists in plant physiology, ecology, mycology, soils, and genetics were located at this facility.

Research objectives for the regeneration project were redefined in 1962 to work toward meeting the following long-term objectives: (1) evaluation of comparative biological factors of establishing plantations by seed or planted seedlings; (2) determination of seedling silvical characteristics of regional tree species to acquire basic information on environmental requirements; (3) improved methods of collecting, handling, storing, and germinating seed; and (4) means for improving survival capacity of nursery stock when outplanted. Five new studies were started during the year, two under cooperative agreement with Oregon State University and University of Washington.

During 1962, Trappe completed a major literature review on the fungus associates of ectotrophic mycorrhizae, which was published in Botanical Review.

The forest genetics project, also headquartered at the Corvallis laboratory, now had a staff of two, Silen, the project leader, and Frank C. Sorensen who joined the Station in July 1962. He had previously worked at the Southeastern Station in Florida. During 1962, emphasis was given to preparing publications on provenance studies, seed orchard technology, species introduction, and genetics of individual traits.

The tree-soil relations project, headed by Tarrant, also spent considerable time during the year on data analysis and preparation of manuscripts. Participation was continued as coinvestigator in a National Science Foundation Grant with Oregon State University. The title of the project was “Influence of *Alnus rubra* on microbial activity and nitrogen transformation in soils,” and it was directed to learning the fertility factors contributed by red alder to interplanted Douglas-fir and the influence of nitrogen transformation, organic matter changes, and soil physical properties.

The two projects located at Olympia were silviculture of Douglas-fir and animal damage control, both headed by Worthington with three assistants on the first and two on the second. Radwan completed a problem analysis for the animal damage project and a short-term laboratory program was planned which would complement the program the U.S. Bureau of Fisheries and Wildlife was conducting from the same facility at Olympia. Immediate plans included study of the properties and effectiveness of chemicals used in treating seed and seedlings and study of factors affecting mammals’ preferences for tree and browse species.

Of the 22 studies underway in Douglas-fir silviculture, eight were completed and terminated during 1962. A new problem analysis was prepared covering the next 5 to 10 years, placing greater emphasis on silvics, intensive management of very young stands, and harvest cutting and rotation age determination. The staff lost George Staebler, who resigned and accepted a position on the forest management research center staff of the Weyerhaeuser Co. at Centralia, Wash. However, much of his work with Weyerhaeuser related closely to studies he had carried on at Olympia, and in his new position Staebler continued to add appreciably to progress in forest management research. Richard L. Williamson was added to the staff at Olympia in midyear 1962, by transfer from National Forest Administration, Region 6.

The two projects located at Roseburg were brushfield reclamation and silviculture of mixed pine-fir forests. Ecological studies of varnishleaf ceanothus were given continued emphasis during 1962 by Gratkowski in a thrust to develop silvicultural treatments that would inhibit encroachment of this pervasive brush species after logging.

Dr. Richard P. Pharis, plant physiologist, was added to the Roseburg staff in 1961 to assist Hallin on the silviculture project there. Pharis had forestry experience in Region 6 prior to graduate study. Since soil moisture is a critical regeneration factor in the area occupied by the mixed pine-fir forests, a study of the physiology of the principal conifers of this type was initiated in 1962. This included collection and analysis of the data comparing relative drought resistance of five major conifers and establishing lethal foliage moisture contents for prediction of plant death.

A single project, silviculture of interior conifer types, was assigned to the Bend forest management staff headed by Dr. Carl M. Berntsen. Emphasis in 1962 was on completion of several long-term studies and continuation of new studies in immature pine stands.

The Station had two projects in Watershed Management Research; one, watershed logging methods and stream-flow regulation, located at Corvallis, covered west-side problems, and the other, water yield and erosion, located at Wenatchee, covered east-side problems. Obviously, some findings developed from both projects had regional and, in some instances, extraregional application. For example, during 1962 the Corvallis staff devoted considerable time to trying, on an experimental basis, to speed up some of the time-consuming processes in watershed management research, including development of data processing electronic programs. The Corvallis project was headed by Rothacher, and Division Chief Dunford, although headquartered in Portland, acted in charge of the Wenatchee-based project pending selection of a leader.

Logging commenced in the fall of 1962 on the two experimental watersheds on the Andrews Forest. The one where the Wyssen skyline crane was used was roadless. Access roads were constructed on the other watershed where the high-lead system was used.

Transpiration and evaporation, the two users of the most water in a forest, require energy which may come from several sources. In an attempt to measure energy input for a given watershed, 14 continuously recording measuring stations were established in or near the Wenatchee River watershed.

Two forest fire research projects were assigned to the Station—fire control and use, and fire weather—both head-quartered in Portland and each staffed with two scientists. More basic forest fire research was being conducted at forest fire laboratories in Missoula, Mont., and Riverside, Calif. Slash burning problems continued to occupy major attention of Morris and his assistant, Harold K. Steen.[33]

The fire-weather project, headed by Owen Cramer and assisted by Lynott, was divided into four fields; fire-weather forecasting, mountain-weather variation, fire-danger systems, and fire-season severity rating. The staff continued to work with new techniques aimed at better understanding of fire-weather[33] mountainous terrain. The program at this Station was fashioned to give continuous and early input for use of fire control organizations of this region which had a high potential for tremendous loss from uncontrolled forest fires.

The Division of Forest Insect Research had five projects, two headquartered in Portland and three located in Corvallis in the new laboratory facility. These projects as defined in 1962 were: (1) bark beetles, sucking, seed, and wood products insects; (2) defoliators, regeneration, and range insects; (3) insect diseases; (4) biological control of insects; and (5) physiology of insects.

33 Steen later completed graduate studies in forest history and was awarded a Ph.D. from the University of Washington and followed a career in forest history. At the time this manuscript was written, Dr. Steen was associate director for research and library services for the Forest History Society, Santa Cruz, Calif.

Additions to the staff were made in 1962. Charles Sartwell joined Wright and Mitchell in Portland on the first-named project in October 1962. After a lapse of several years, research on pine bark beetles was resumed and evaluations were made in 1962 of Oregon ips and mountain pine beetles in young ponderosa pine stands. Studies of the relationships between the balsam woolly aphid and its true fir host trees were conducted during 1962 in search of learning if silvicultural practices could be used in reducing damage from this insect pest.

Carolin and Coulter, working from Portland on the second project, singled out the spruce budworm and hemlock looper as the principal defoliators for study during 1962. The European pine shoot moth continued to attract major attention among the regeneration insects; and the Station issued Research Paper 47, which described the fumigation treatment developed and explained its use which was prescribed in quarantines imposed by Oregon, Washington, and other Western States to halt the spread of this insect invader.

Staffs of the three projects located at Corvallis spent considerable time in 1962 moving from the university laboratories and offices, where they had been working, into the new facility. Equipping the new laboratory with scientific equipment also was an important activity during the year. An electron microscope was purchased after considerable correspondence and red tape untangling. The Station's choice was a Philips, made in Holland and reportedly the best available, and justification had to be made for not purchasing a more expensive American product or a less expensive Japanese made. Installation of it and supporting special equipment commenced late in 1962. Development of research programs also was given prime attention. Dr. Gertrude C. Wittig, at that time with the ARS, was added to the staff of the insect diseases project in January 1962 to assist Dr. Thompson. She had a scientific education in Germany and had further training in Berkeley under Dr. Steinhaus and was a qualified electron microscopist. With this equipment and staff, basic studies of insect viruses and their actions could be undertaken successfully.

Dr. Roger B. Ryan, working alone on biological control of insects, was studying the effects of light and temperature upon the seasonal activity of an important native insect parasite of the Douglas-fir bark beetle. He was also making major efforts to develop methods of mass rearing of parasitic insects in the laboratory.

The third Corvallis forest insect project, physiology of insects, was also a single-scientist effort at this time. F. H. Schmidt, the project leader, had made a start on defining physiological characteristics of the green and standard forms of the spruce budworm.

It was anticipated that as the Corvallis laboratory was equipped and functioning, laboratory technicians would be added to the staff on a full-time or part-time basis to assist the principal scientists. The university was expected to be a source of supply of qualified undergraduate and graduate students for such employment.

Four projects were underway in Forest Disease Research during 1962. A staff of four, including Division Chief Childs, was working on forest disease control. Thomas H. Laurent joined Aho and Edgren in June 1962 by transfer from the Alaska Research Center. Most of the efforts on this project, working out of the Portland office, had been on heart rots of true firs and associated species in the upper-slope types and on ponderosa pine dwarfmistletoe for the past 3 or 4 years. The heart rot problem in decadent old-growth stands was one of accurate estimation of volume and extent of decay in individual trees to facilitate waste reduction in harvesting such stands since, strictly speaking, control of heart rots in these stands is an impossible task.

The forest root diseases project, also headquartered in Portland for the time being headed by Childs assisted by Nelson, was still almost entirely concerned with *Poria weirii.* However, increased activity of *Armillaria mellea* called attention to the need for effective measures to control this root disease, particularly to protect seed orchards.

Only a few small studies were underway in 1962 on nursery, plantation, and forest products diseases.

The soil microbiology project was planned to be one of the principal Forest Disease Research activities at Corvallis. Dr. Bratislav Zak transferred from the Southeastern Station to Corvallis as project leader. Work had been begun by Dr. K. C. Lu on the influence of soil nitrogen on microorganism populations of Douglas-fir and western hemlock roots. This work was coordinated with research by Dr. Walter B. Bollen of Oregon State University on nitrogen fixation by the red alder nodule bacterium.

The Division of Range, Wildlife Habitat, and Recreation Research program was comprised of three projects. The range ecology and management project was located at La Grande and staffed by Garrison, Strickler, and Skovlin. Four phases of this project were under study during 1962; grazing management, interrelation of timber and forage production, range condition trends, and measurement techniques of species frequency and density. The last two named were completed during the year and preparation of report manuscripts commenced.

Nominally, the big-game habitat project was centered in Portland, although field personnel were working from three center headquarters. It was planned to move the project leader, Justin Smith, to La Grande, Oregon, in 1963 and establish the headquarters there with satellites at Bend and Wenatchee staffed by Dealy and McConnell, respectively. At this time, studies were grouped under two broad fields; ecology and physiology of wildlife habitat and wildlife habitat, livestock, and forest management interactions.

Staff of the newly named wilderness recreation dynamics project, located at Portland, was increased by the addition of William R. Burch, Jr., a social science analyst, late in 1962. Burch's training supplied a fresh point of view to these studies. Currently, Wenger and Burch were studying some of the variables associated with choice, commitment, and persistence in easy-access versus wilderness outdoor recreation. Methods for adjusting data collected from the unmanned registration stations, established the year before, were tested to account for persons failing to register.

The program of Forest Economics Research increased in scope and intensity with several important staff additions, some under permanent appointment and two under temporary arrangements. The division had five active projects, one of which, survey techniques, was moved from direct supervision of the director to the division to insure close cooperation and guidance from the forest survey project. However, the same study program continued to function as before in close cooperation with the Regional Office and the Forest Insect Research Division. New activities of the survey techniques group in 1962 were preparation of several guides in evaluation of brushfields in southwestern Oregon and planning thinning operations in young-growth Douglas-fir.

The forest survey field reinventories continued to move ahead at a satisfactory rate, with 5.8 million acres of commercial forest land covered in six southwestern Oregon counties in 1962. Collection of increment cores for the cooperative western wood density survey was completed by the survey crews during the year.

Charles L. Bolsinger was added to the permanent forest survey staff in June 1962. He had previously worked on the survey several summer seasons while an undergraduate forest school student, as did several other members of the staff.

Dr. Richard C. Smith, on sabbatical leave from the forest school faculty of the University of Missouri, also joined the survey staff in July 1962 under a year's appointment. Smith assisted Gedney in evaluating future prospects of the timber industries of the Columbia Basin for the Bonneville Power Administration.

Another addition under temporary appointment to the Economics staff was Dr. Walter H. Mead, an economist from the University of Oregon, with a special interest in timber industry problems. He was assigned to the forest products marketing project staff, joining Adams and Binkley. Mead commenced an analysis of public timber sales in the region for the past decade, with the objective of isolating and defining the principal factors influencing the bid prices on Forest Service and BLM timber sale offerings.

Adams, the acting project leader, continued to analyze thinning costs and values in young-growth Douglas-fir stands. Binkley made progress in study of the economic and engineering aspects of skyline logging methods on operations underway at Cascade Head and the Andrews Experimental Forests.

Collection of data on log and lumber exports from the Pacific Northwest to the Orient, principally Japan, was established as a regular service of the division. Although overall impact of this trade had moderated since 1961, public interest was still compelling. Some of the Douglas-fir export logs were coming from thinnings on industrial tree farms under a managed program which would complement regular domestic markets for round timber products.

The remaining two projects of the division, multiple use economics and production economics, were being directed by Newport until project leaders were selected and assigned. Jay M. Hughes was added to the staff of the multiple use project by transfer from the Rocky Mountain Station, replacing Rickard who resigned to reenter private forestry employment. New studies were planned in 1962 to work on the most pressing problems developed from higher intensity of timber management which produced many real or apparent conflicts of uses.

Changes were made in the staff of the production economics project with the transfer of Dr. John Fedkiw to the Washington Office of the Forest Service on May 15, 1962. Dr. Donald F. Flora, who was appointed in June 1961, filled in the opening left by Fedkiw. McMahon was also moved from the marketing project to this one in 1962. During the year, a cooperative agreement was negotiated with the Bureau of Land Management to provide them with an economic analysis and advice regarding intensive public management of young growth on a 55,000-acre study area in Tillamook County, Oregon. Another cooperative project with Weyerhaeuser Co. and the University of Washington, commenced in 1962, was a study of financial aspects of advance roading to provide for thinning otherwise inaccessible stands. Work was done on the Weyerhaeuser Timber Co.'s Clemons Tree Farm in the Grays Harbor area.

Work of the Division of Forest Utilization Research was divided among three projects: log and tree grade development, utilization improvement, and forest engineering; the first two located in Portland and the last one headquartered in Seattle, Wash.

A major activity of the five-man staff of the log and tree grade development project during 1962 was the collecting of timber quality data for western larch and inland Douglas-fir.

Worth, leader of the utilization project, worked closely with Region 6 engineers and architects to improve the design and construction of wood structures. The new Forest Sciences Laboratory at Corvallis was an example of a one-story post and beam wood structure that was economical, efficient, and attractive, as well as functional as a scientific laboratory. On Columbus Day, October 12, 1962, a windstorm of unusual force hit a large part of western Oregon, causing extensive damage to buildings as well as timber blowdown. The Corvallis laboratory structure performed perfectly during this severe test. The other two laboratories, at Wenatchee and Bend, under construction in 1962, were basically the same wood design as the Corvallis laboratory, although the Wenatchee laboratory was two stories. From advance interest in the Corvallis structure, it was expected these buildings would lead to greater interest in wood-constructed buildings for similar uses.

Fire lookout towers were another product of team development and promotion of wood structures by the Madison Laboratory, Station, and Region 6. A prototype of a new design was planned for installation in 1963 on the Snoqualmie National Forest in Washington.

Hilton Lysons, mechanical engineer, was pointed in November 1962 to head the forest engineering project which was headquartered in Seattle. Some preliminary work was underway. This work would be incorporated in a broader program to be developed under Lyson's leadership. First emphasis was planned for timber harvesting under a program which would use systems-engineering principles.

Growth of the Station as a whole and concentration of activities at locations like the Forest Sciences Laboratory at Corvallis demanded a strengthening and rearrangement of business management activities. Sam Kistler retired March 29, 1962, after 27 years in Forest Service business management work, the last 16 of which were at the Pacific Northwest Experiment Station. Charles J. Petersen transferred to the Station from Region 5 of the Forest Service to fill the vacancy. On March 4, 1962, George Booras transferred from the Region 6 Division of Operation to be administrative officer for the Corvallis laboratory center.

Nineteen sixty-three was a golden anniversary year for the Pacific Northwest Forest and Range Experiment Station. Its predecessor, the Wind River Forest Experiment Station, was established in 1913 in the Wind River Valley, which very appropriately is in the Gifford Pinchot National Forest perpetuating the name of the first Chief Forester.

Another event occurring in this year has historical connections. On March 3, 1963, Robert W. Cowlin retired as director of the Station and was succeeded by Philip A. Briegleb, at that time director of the Southern Forest and Range Experiment Station in New Orleans, La. Both Briegleb and Cowlin commenced their Forest Service careers the same year, 1929, at this Station under its first director, Thornton T. Munger. Briegleb reported a few months before Cowlin and was first assigned to the Wind River Experimental Forest, as it was known then. Briegleb was also the more peripatetic of the two, having also served in the intervening period between tours of duty at this Station at three other Federal forest experiment stations and as director of two or them, the Central and Southern Stations. Cowlin, on the other hand, spent his entire Forest Service career at this Station in Portland.

It was fitting that the annual report of the Station for 1963 should review some of the early research of the Station done by the pioneers of forest research in this region in the context of a half century of progress. It is also appropriate that first mention in this year's history should record activities in "timber Management Research."[34] Growth and yield of Douglas-fir has been a major activity of this Station and its predecessors for more than 50 years, and it still is an active and important field of study.

In 1962, a cooperative research project was commenced to obtain more exact information on stocking schedules for optimum production and yield estimates for intensively managed stands. This project, based upon a common plan developed by G. R. Staebler, was called levels of growing stock. Four studies were installed in 1962 and 1963. Two by Weyerhaeuser Co. were on Douglas-fir sites I and II of company lands. Oregon State University installed a study on site II lands owned by T. J. Starker. (T. J., a pioneer forester in his own right, dated back a half century in forest research.) The fourth study was installed by the Station on site IV land on the Olympic National Forest.

The Douglas-fir heredity study, which dates back to 1912, is another example of a pioneer study continuing to produce important results. One of the most striking of these was the evidence for a gene-environment reaction. A major generalization made from this interaction was that within the Douglas-fir region, there is a strong adaption of seed for specific localities. In a sense, an anomaly to this interaction exists in the fact that without exception the progenies of every parent include at least one superior individual at each location.

34 This division was formerly called Forest Management Research. Propensity for new nomenclature and changes in organization structures are apparently a bureaucratic characteristic.

Since forest planting has been done in the Pacific Northwest, shingle two had been used as packing material around seedling roots. Recently, it was found that natural fungicides existing in cedar wood are toxic to Douglas-fir under some conditions, contributing to poor survival. Use of alternative seedling packing material was begun in Forest Service nurseries in 1963.

A study recently completed showed seasonal trends in development of natural resistance in Douglas-firs and ponderosa pines to herbicides and that associated brush species were still easily killed when the trees were resistant. Taking advantage of this situation would permit aerial application of herbicides to release young conifers from brush. There were thousands of acres in southwestern Oregon and northern California in need of brush control to release good stands of ponderosa pine and other conifers under dense brush cover.

Research on noble fir, a major commercial species of the upper-slope types, was receiving greater attention by the Corvallis silvicultural staff. Improved methods of regeneration were a particular object of this program. Also, a comprehensive study of successional relationships and productivity of noble fir in various plant communities and on differing soil types was commenced in the Washington Cascades where the species flourishes.

Fifty years of research in forest tree diseases produced a great deal of information, much of it put into application immediately. However, a large number of the forest tree disease problems require a long-time painstaking approach. The early programs were dominated by a series of obvious problems. First concern, starting in 1913, was with *Elytroderma* needle cast and dwarfmistletoe. The needle cast was a sporadic pest, influenced by climatic cycles and only moderately damaging at activity heights. Dwarfmistletoe had been a major pest for 50 years or more. Studies were still continuing on this disease at this time. In the 1920's, a great deal was learned about Douglas-fir stem rots which was of much value in timber management planning and practice. During the same period, the Olympic blowdown diverted attention of the forest pathologists to study of the rate of deterioration of windthrown timber. Results of these studies were also useful in salvaging timber in other tree-killing catastrophe areas such as the Tillamook Burn. The discovery of white pine blister rust in the West during the same period resulted in a research and control program which took precedence over all other disease problems.

More recently, root diseases had been a major activity of Forest Disease Research at the Station. Study had shown that practical control of *Poria weirii,* a top enemy to young-growth Douglas-fir management, might be attained through changing the environment to increase effectiveness of soil microorganisms antagonistic to *P. weirii.* The availability of the Corvallis laboratory facility and staff additions provided the opportunity for more intensive study of this and other unsolved problems in forest pathology, and was expected to result in a well-balanced research program.

Sixty years before 1963, a study was made of the "span worm." It had defoliated extensive stands of spruce-hemlock in the Grays Harbor area for the previous decade. This insect proved to be the hemlock looper, and again it was threatening timber in the Willapa Bay area immediately south of Grays Harbor. A large-scale aerial spraying program was needed in 1963 to control this outbreak, offering an opportunity to pilot-test a microbial insecticide, *Bacillus thuringiensis,* in a newly developed commercial form believed harmless to humans and other animal life. Laboratory tests in 1962 had shown it to be lethal to hemlock looper. A 325-acre test area was aerially sprayed by helicopter on an island in Willapa Bay in the summer of 1963. Unfortunately, the tests showed that *B. thuringiensis* in this formulation was not effective enough in operational use to control this insect. This failure emphasized the continued need for intensive laboratory research on biological control agents against this and other destructive forest insects. The Station was now in a position to expand this avenue of research.

In the summer of 1963, the forest fire research staff commenced field observations on the Cascades fire-weather project on a 35-mile-square area of mountainous country in the Cascades southeast of Portland which extended over a 4-week period. There were many cooperators on this project, including seven ranger districts of the Mount Hood National Forest, the Clackamas-Marion Fire Patrol Association, Region 6 Division of Fire Control, a meteorology section of the Army's 4th Division from Fort Lewis, Oregon State University, and other forestry agencies adjoining the study area. Surface observations of weather factors were made from 26 stations at 3-hour intervals for 18 days. The Station's Cessna 180 made aerograph flights to record temperature and humidity over a 250-mile pattern twice daily. Rawinsondes were released during two of the test weeks. Seventeen were tracked by the Army meteorologists from Timothy Lake using a radiotheodolite, and five were released by Forest Service personnel from Goat Mountain on the western edge of the range and tracked by the Weather Bureau from Salem. Winds aloft were observed by an Oregon State University radar set in the study area by tracking aluminum chaff dropped pattern-wise during the Cessna aerograph flights.

The Station fire researchers also made a mesometeorological study of the 1962 Columbus Day storm in cooperation with Region 6. It was an extreme example of wind during slash burning season.

Watershed Management Research, a relative newcomer in the Station as a separate entity, had a historical back-ground in the Pacific Northwest nevertheless. Some of the early studies at the Wind River Station were concerned with soil and water problems under the name of forest influences and were included in forest management study programs.

Completion of the Forest Hydrology Laboratory in July 1963 marked the start of a new chapter in watershed management research in the Columbia River Basin where water is probably the most critical natural resource. It would take a year or more to fully equip and get this facility functioning smoothly. Field studies, however, would continue to be a major part of the division's program regionwide. Improved technology would permit more basic studies in the field. For example, during 1963, Wenatchee personnel used radioactive ferric chloride, applied in solution to soil surfaces, to trace erosion. Evidence of soil movement was determined by radiation intensity measurements.

Range Management Research in the Pacific Northwest dated back nearly 60 years, but there was a long period when little was done in this field of study. However, about a quarter of a century before 1963, a viable program commenced. By 1963, a well-balanced and productive program in range and wildlife habitat was underway and an outdoor recreation program was getting started in a promising fashion.

For the past decade, a study of forage production in relation to timber management had been given major effort. A study of the impact of logging on herbs and shrubs and their recovery had given information on amount of soil and understory vegetation disturbance by four logging systems. Immediate effects of tractor logging were found to be seriously disturbing to soil and to the forage resource. The other three systems, jammer, horse, and the Wyssen skyline, caused deep soil disturbance on only a small percentage of the logged area.

The first study in wilderness recreation dynamics was concerned with test of methods to obtain from wilderness users information concerning their experiences, attitudes, and personal characteristics. It was also designed to obtain from respondents a measure of values that arise from wilderness use. Tests made during 1963 and prior years indicated that important and useful information could be obtained regarding forest recreation by well-designed and systematic observations.

The Station's office of biometrics research not only performed a valuable consulting service to the research scientists and carried on a training program in advanced methods of statistical analysis, but also conducted and reported on a study program of its own.

A statistical study, completed in 1963 and published in the Journal of Forestry, presented evidence that sample log scaling could reduce cost of conducting a timber sale considerably and that this saving was only partially offset by probable sampling errors.

Use of electronic computers for processing timber cruise data created an opportunity for replacing volume tables by equations. Johnson developed six tree volume equations in 1963, two of which were immediately put to use in calculating allowable out by Federal forest agencies. The six equations and description of development procedures were published by the Station in a Research Note. Another example, also published during 1963, was a description of analytical procedures for use of stem analysis data for developing site index curves.

Although pioneer forest research was largely concerned with the biological and physical sciences, the social sciences were not entirely ignored in early study program considerations of the Forest Service. Forest economic studies, in a formal way, were underway at the Pacific Northwest Station dating back to 1928. In very recent years, a great expansion took place in Forest Economics Research. As a large mass of data accumulated regarding protection and management of the forest resource for use of public and private forest-land managers, critical decisions had to be made on how, when, and where to put this scientifically based information into practice. Sometimes the answer could be made readily by use of experience and judgment, but more often a judgment had to be made that required a fairly precise estimate of costs of application and tangible benefits accruing. Economic analysis, supported by electronic data processing and sophisticated procedures, became an important part of the Station's program, and by 1963 a number of studies of this nature were underway. A comprehensive study of ponderosa pine dwarfmistletoe control opportunities was an example. Costs of eradication under various stand conditions, using time study techniques, were determined during the year. Study of followup costs and the returns gained was a continuing phase of the study, using data being collected by the Division of Forest Disease Research at this Station and the Rocky Mountain Station. Another study of this nature, in progress during 1963, was trends in reforestation and its cost. Since 1962 total costs of reforestation in the Pacific Northwest were $7.5 million, economic considerations were a vital factor.

In forest products marketing, a cooperative agreement was made with Oregon State University for an econometric analysis of demand and supply relationships in the Douglas-fir plywood industry. This study described plywood markets in mathematical equations forecasting prices, production, and new orders.

The reporting of export of logs and lumber was expanded to satisfy demand for more related information. The first of a series on stumpage and log supply was issued for the second quarter of 1963. It gave information on stumpage supplies and prices, log and lumber production trends, log and lumber exports, and other related information concerning the timber situation in the Pacific Northwest.

Two important publications bearing on the timber resources of the Pacific Northwest were issued during 1963. "Timber Trends in Western Oregon and Western Washington," U.S. Forest Service Research Paper PNW-5. October 1963, was the product of several years of detailed study of the Douglas-fir subregion, made in response to an aroused public concern for the future of the Pacific Northwest forest economy. Although authorship was given as "Division of Forest Economics Research" and no individual author was named in the report, Dr. William A. Duerr contributed a major part of the analysis and report preparation; however, many others of the staff contributed. In fact, this work was commonly called the Duerr report when it was in manuscript form and in the review process. The objective of the report was to present a long-term appraisal of timber supplies of the Douglas-fir subregion. In the course of the study, information was obtained from many private and public forest-land owners and managers. Forest survey data were used freely. Projects of cut and growth were applied to the timber inventory of the 1950's, tracing future development of the timber resource under various assumptions. The economic model used in the study was concerned mainly with the long-range output that might be expected under long-term influences of various economic forces. Short-run considerations, such as impacts on prices and profits of alternative cutting policies, were not considered.

Originally, the report and manuscript included a chapter analyzing the situation under an accelerated program of harvesting old-growth stands on public lands as a measure to attain a higher potential level of allowable cut. After in-Service critical review and much discussion with the Regional and Washington Offices, it was omitted from the published report for reasons largely based upon timber management policy considerations.

A second major publication was “Toward Complete Use of Eastern Oregon’s Forest Resource,” U.S. Forest Service Resource Bulletin PNW-3, by Donald R. Gedney. This was a comprehensive analysis of the forest resource situation in eastern Oregon. Future opportunities for growth through management of the resource were developed. The premise was advanced that the future growth and development would depend a great deal upon full utilization of the forest resource obtained through product diversification and refinement by the timber industry.

The division’s newest project, multiple use economics research, gave top priority to study of wilderness land allocation in the Pacific Northwest. Political, sociological, and economic considerations entered into this problem and there was no precedent for selecting techniques for analysis; accordingly, a first step was the determination of appropriate techniques. At this time, the joint study of the outdoor recreational potential by the Departments of Agriculture and Interior of the North Cascades of Washington was underway, and the Station economists participated in it.

Improvement of the degree of utilization of the timber products resource had been a major activity of the Station’s program for three decades or more. This program embraced a wide range of studies, with many changes as new technology developed. The focus of this work was the maintenance of constant and close liaison between the Madison Forest Products Laboratory and regional timber products technologists and timber industry managers. A 1963 example was the study of internal tree damage produced by severe windstorm, such as the 1962 Columbus Day storm. Forms of internal damage such as splits, windshake, and crossbreaks were usually quite easily detected. Other forms, such as compression failure, presented problems of identification. The study, commenced in 1963 in cooperation with regional products research laboratories and Madison, was directed to develop methods for (1) early identification of significant structural damage, (2) description of degree of damage, and (3) definition of acceptable limits of wind damage in timber products.

The forest engineering program, the newest of the Station’s major activities, was attracting great interest and cooperation. A subcommittee on forest engineering was appointed as part of the Station’s advisory committee, composed of leading people of the logging industry. Regions 6 and 10 of the Forest Service and the colleges of forestry and engineering of the University of Washington gave active support and cooperation to this research from its inception, leading to establishment of the headquarters of this project in Seattle, Wash.

The problem of logging steep slopes with a minimal amount of soil disturbance was broadened to include the feasibility of logging with balloons, as well as improvements in skyline systems and use of helicopters. The prime objective of the helicopter study at this time was to develop power-operated log grapples to facilitate log pickup and release.

A static test and evaluation of dual and wide, single, off-highway logging truck tires was completed in 1963. It was the first phase of a road-design, cost-reduction program, and a second phase was planned which would be construction and operation of a road test section for dynamic tests.

The timber quality study of improved inland Douglas-fir sawtimber was in the final testing stage in 1963, and an improved log grading system was scheduled for use early in 1964.

In 1963, the Station conducted lumber grade recovery studies for ponderosa pine, using an improved log grading system developed by the Pacific Southwest Station.[35]

35 Dr. Carl Newport directed this study while at the Pacific Southwest Station and continued to advise on the study after transferring to Portland.

CHAPTER VI. The Station Meets New Challenges and Responsibilities As Public Concern for the Forest Environment Mounts—1964-71

Introduction—General Inspection and the Advisory Committee Review Programs

Two events during the closing months of 1963 marked the end of the first half century of organized Federal forest research in the Pacific Northwest. During the fall, a periodic general integrating inspection of Region 6 and the Station was made by a Washington Office team consisting of Deputy Chief Hamilton K. Pyles and General Inspector Russel B. McKennan.

Although the field inspection covered only several weeks, considerable additional time of the Director and principal staff officers of the Station was spent in preparing plans and statements for the inspectors and in reviewing and commenting on the first and final drafts of their report, extending well into 1964.

The stated purpose of such inspections is to determine the overall effectiveness of Forest Service agencies and activities within the territorial unit being inspected (Pacific Northwest forest region in this case). The inspection is designed to give the Chief and his staff a critical measure of the performance of the Region and Station in meeting their basic responsibilities and the quality and completeness of objectives, policies, plans, and procedures. However, by its very nature, such an inspection must be broad brush as far as Station research projects and their implication are concerned. In an important timber National Forest region, such as the Pacific Northwest, major attention and emphasis tends to be given administrative policies and problems. Also, not uncommonly, attention of the inspectors is drawn to isolated single instances of some action or occurrence.

However, these inspections, which occur at 5-year intervals, are not without value to the Station but are exceeded in usefulness by the general research inspection and the functional inspections which are made by Washington Office research personnel. The latter type of inspection gives an intensive and objective appraisal of research performance by a peer group.

The second notable event of 1963 was the eleventh meeting of the Pacific Northwest Forestry Research Advisory Committee, held November 21 of that year. This group had been functioning for over a decade with a number of the original members still serving. Composed of leading private and public professional foresters, it was particularly useful to the Station in giving a critical appraisal of the effectiveness of its research program as measured by the extent and promptness with which its results were put into practice and in recommending program action to meet the needs more effectively. It also was invaluable in coordinating Station programs with other regional forest research and in stimulating additional cooperation and in establishing priorities.

The G.I.I. report was generally laudatory of the Station's performance, and it singled out a number of fields of study that needed strengthening: animal damage; regeneration, particularly on upper-elevation types and on south slopes; steep-slope logging systems; and mensuration. In its report, the advisory committee duplicated these recommendations and added a number of other fields of study and specific problems in forest management, watershed, recreation, range and wildlife research, forest protection, forest diseases, forest engineering, forest products utilization, and forest economics and marketing research in need of attention. Animal damage was judged to be an extremely serious obstacle to obtaining successful regeneration. Altogether this was a large order. However, it was recognized by both groups that additional funding was necessary.

The G.I.I. report also made comments and recommendations on Station organization and referred specifically to the shift from a research center organization to a project type of organization which had been underway for several years. Emphasis was also given in the report to the need for increasing the ratio of support personnel to scientists.

Support Services and Research Facilities Strengthened

Strengthening support services was greatly advanced during 1963 and 1964 by reorganization, upgrading of positions, and recruitment of skilled personnel. Under the direction of Assistant Director Harris, a unit organization was developed consisting of the following sections: Operations; Programming and Statistics; Information and Education; Library; Publications; and Architectural and Engineering and staffing to match.

In July 1964, "Benny" Di Benedetto, architect, was transferred by Region 6, Division of Engineering, to the Station's Division of Station Management. Also during 1964, the electronic data programming section was transferred from the supervision of the office of biometrics to the Division of Station Management. Another milestone in the development of field laboratories occurred with the dedication of the Forest Hydrology Laboratory at Wenatchee, Washington, and the Silviculture Laboratory at Bend, Oregon, in the spring of 1964. Funds available in fiscal year 1963 enabled the completion of the buildings and equipping of these much needed facilities.

Although both of the buildings featured wood, the Silviculture Laboratory at Bend used this forest product especially. This building and its architect received a merit award by Architectural Review.

In April 1964, Secretary of Agriculture Freeman transmitted the Forest Service "A National Forestry Research Program" to the Congress. Actually, at that time the program was in the third year of the proposed 10-year coordinated research effort. It was estimated that about 40 percent of the national program was activated or about to be so. Work relating to the Pacific Northwest was proceeding at about the same pace. Although fiscal year 1964 overall allotments to the Station included only a modest increase over funds available the preceding year, more money was available for research programs as a result of completion of the first phase of the laboratory construction program. Forest Insect Research in particular received a substantial increase. Forest Management Research also received a needed increase, but on a smaller scale. However, in fiscal year 1965, commencing July 1, 1964, total allotments increased more than 15 percent over the year before, raising the Station's annual allotment to over $2 million for the first time. Substantial increases were received for Timber Management Research, Watershed Management Research, and Forest Engineering Research.

Increases Fund New Programs and Personnel

Harvesting timber from areas of difficult access was given top priority by the Forest Engineering staff under the leadership of Hilton Lysons, who received a permanent appointment at the Station in November 1963. Others on the staff were Virgil Binkley and John O'Leary (the latter was on leave from the School of Forestry, Oregon State University). This small group completed some important studies in 1964. For example, one study concluded that as much as 20 percent of logging road surfacing costs might be saved through use of new wide single tires on logging trucks in place of the conventional dual tires. However, the study which attracted greatest public attention concerned balloon logging. In order to make an engineering evaluation of balloon logging potential, the Station contracted for two studies in 1964 with the Goodyear Aerospace Corp. Results of the first study were published by the Station in 1964 under the title "Balloon Logging Systems, Phase I," 111 pages, illustrated. This analytical study provided basic information on this method of logging as a potential solution to problems of logging steep slopes. Binkley also delivered a paper which was published in Auburn Forestry Proceedings on research objectives and developments on the concept of vertical logging with helicopters.

Research to improve timber quality evaluation was strengthened through addition of Richard O. Woodfin, Jr., to the staff of the log and tree grade development project headed by Paul Lane. Major attention was given to coast-type Douglas-fir. Data gathered during the year comprised about one-third of the total planned. Completion of this study was expected to lead to improvements in timber cruising, refined log grading systems, and more profitable log use.

Following the Columbus Day storm of 1962, a comparative study was made of high-lead yield yarding in wind-thrown and standing timber. It was found that tree-length yarding in the blowdown area increased logging output per man-hour 27 percent when compared with conventional bucking and yarding in green standing timber.

The quarterly reports begun the previous year on stumpage and log supply by the Division of Forest Economics Research were broadened in 1964 to give greater emphasis to imports and exports of logs, lumber, and other forest products, and to regional production and employment in the timber industries. Reports containing this information were to be published in a series titled “Production, Prices, Employment, and Trade in the Pacific Northwest Forest Industries.”

These reports proved to be a valuable source of information for business analysts and were quoted regularly by business sections of Pacific Northwest daily newspapers and trade journals.

Since construction is the greatest single market for Pacific Northwest lumber products, the Station planned to study critical wood construction problems and to search for new construction opportunities for western wood products. Work was planned for cooperation with timber and construction industries, the Madison Forest Products Laboratory, and the regional universities. A major objective was to maintain and recapture the markets against competing and substituting materials.

Results of a study by Dr. Walter J. Mead[1] cooperating with the Division of Forest Economics Research, were published in the Station’s Research Paper PNW-9, “Mergers and Economic Concentration in the Douglas-Fir Lumber Industry, 1964.” .

During 1964, the forest survey staff completed the Pacific Northwest tabulations and analyses for the national review of timber resources, “Timber Trends in the United States.”

The survey techniques research project was strengthened by recruitment of Paul M. Haack, Jr., late in the year, giving Pope some much needed help.

A new project, multiple use economics, got underway during the year under the direction of Dr. Jay M. Hughes, who joined the Economics staff near the end of 1962.

Forest mensuration was reactivated late in 1964 on a project basis with David Bruce in charge, headquartered in Portland, and plans were made to add another scientist to the project in 1965. Ambiguous units of timber measurement and inadequate methods of predicting growth and yield weakened estimates of usable wood volume in trees and potential yields of forest stands, resulting in undependable allowable cut calculations. This new project would be dedicated to overcoming these shortcomings.

1 On leave from the faculty of the University of California at Santa Barbara.

Research Tackles Many Regeneration Problems

The Timber Management Research staff gave increasing emphasis to the many problems occurring in growing a new timber crop. Currently, more than 125,000 acres were planted annually in the Pacific Northwest. Vigorous planting stock that survived well and grew rapidly was a prime necessity to support this program. To learn how to build more vigor into nursery seedlings, studies of seasonal variations in food reserves in relation to root and top growth in Douglas-fir were made at the Wind River Nursery. It was found that food reserves peaked in the winter months and that as roots and shoots grew in early spring, food reserves diminished continuously. Late summer buildup of reserves is depleted by early fall growth. With this information on sequential changes, nurserymen can take advantage of high food reserves by lifting stock when it is best prepared for rapid growth after outplanting.

Regeneration of dry south slopes in southwestern Oregon was a longstanding and serious problem. A cooperative study with Oregon State University showed that Douglas-fir seedlings from a dry interior seed source were significantly more drought resistant than seedlings from a wet, coastal seed source. This finding pinpointed seed source as a very important factor in survival of Douglas-fir seedlings on dry, south slopes where regeneration is difficult.

Addition of Dr. Frank C. Sorensen in 1964 to the forest genetics staff at Corvallis made possible increased attention to seed orchard technology. Numerous problems were developing as seed orchards were being established in greater number by public agencies and private companies in the Pacific Northwest. A recent result from seed orchard research showed that cone production in any given year is correlated with numbers of male buds formed the preceding year. Since male buds at low elevation can be reasonably well identified as early as May, an initial estimate of cone production can be made 16 months in advance of seedfall. Ability to predict the next year's seed crop as early as July is valuable information for seed-collecting agencies so that collection plans for the current year can be adjusted to accommodate size of the crop in the following year.

A wide range of studies on the economies of timber production was underway during 1964. Results of these studies assisted in marking trees to be left or cut in a thinning or stand-improvement program. One case study demonstrated an effective method of evaluating alternative Douglas-fir management programs. In a broader view, decisions about forestry investments must consider the uncertainty of future costs, prices, and other such relevant factors. During 1964, a study of this problem concluded that uncertainty can be ignored generally when forestry investments whose returns are about equidistant in time are compared. Results of this research were published in the Journal of Forestry (vol. 62, pp. 376-380) by Dr. Donald F. Flora.

Protection of the forest values arising from multiple use is of increasing research interest. With three modern science laboratories equipped and ready for use, the Station was in prime position to intensity all aspects of forest protection.

Biological Control of Forest Pests Emphasized

The electron microscope, installed at the Corvallis Laboratory in 1963, was tested and adjusted and put in use in 1964. At first it was used to explore the mode of action of viruses, preliminary to use of viruses for effective control of damaging forest insects. Also underway at the Corvallis Laboratory were studies of the responses of the principal insect blood cells to *Bacillus thuringiensis* and other pathogens injected into the late-stage larvae of the army worm. Studies of insect blood were to be transferred to insect defoliators when laboratory rearing techniques were developed for them.

Recommendations by the Northwest Forest Pest Action Council that the European pine shoot moth be eradicated resulted in giving the Station responsibility for developing practical measures for eradication of this pest.

Findings of research by the Station and Oregon State University during the year were significant steps toward ultimate control of forest root diseases by natural means. It was found that organic soil amendments increased populations of soil molds antagonistic to many root pathogens.

Strengthening of pesticide-related research would accelerate study of factors affecting *Poria weirii,* diseases of fine roots and population levels of soil microorganisms that may hinder spread of root pathogens. Multiple Use Influences Research Programs

A new project was activated in the fall of 1964 to study the use of pesticides in forest and rangeland management and their relation to the soil and water environmental factors. Systemic chemicals have been used as fertilizers, insecticides, fungicides, antibiotics, herbicides, and growth regulators. Their efficient use in animal damage control was still underdeveloped. Work at Olympia in cooperation with Federal wildlife agencies was strengthened to overcome this deficiency of knowledge. Studies also at Olympia were underway to learn more about the impact of animal damage on Pacific Northwest forest stands.

The Station prepared an interim fire-occurrence factor for use in the Pacific Northwest in the new National Fire Danger Rating System.

A study of top and branches blown off standing trees by the Columbus Day 1962 storm showed large quantities of this fuel hazard in 50- to 100-year-old stands, but not in younger or old-growth stands.

Cramer reported on the mesometeorological research project in the Cascade Range at the annual meeting of the Oregon Academy of Science in March 1964.

Research on the Andrews Experimental Forest watersheds showed that since timber cutting began, large increases in minimum late-summer streamflow have occurred as more of the drainage area was cleared.

During 1964, measures were initiated to establish the 4,920-acre Entiat experimental watersheds on the Wenatchee National Forest on the east slopes of the Washington Cascades.

Tracing soil erosion with radioactive iron on eroding sandstone soil was used to study soil movement. The erosion pattern developed indicated that once soil particles in this soil type were detached and eroding, they continued to move downslope. Plans were made to make further tests on other parent soil materials in hopes of finding an effective tool for assessing soil erosion on a variety of forest and rangelands.

Basic research involving a method of measuring transpiration in which a branch is enclosed in a transparent chamber was tested in the field with Douglas-fir.

For several years, the Range Management Research staff had been preparing a range plant list with electronic data processing symbols current with the latest developments in taxonomy of Northwest plants. With the cooperation of the OSU Range Management Department, the first printout of the list was made in 1964. Measuring over 50 feet in length, instructions were also prepared for revising the list.

Fence-line comparisons of heavy vs. light and moderate vs. light summer cattle use on uniform antelope bitter-brush stands showed a highly significant reduction in shrub density under heavy grazing but none under moderate grazing.

Comparative studies of patterns of use of various range forage plants by deer and cattle provided guidelines for proper intensities of grazing by these two kinds of animals.

Based upon methods previously developed by the Station to gather basic information about use of wilderness areas, the forest recreation research staff commenced a definitive appraisal of use on two Pacific Northwest wilderness areas. A preliminary finding was that wilderness recreation is largely a family activity, a fact that administrators should consider in their plans for such areas dedicated to this purpose.

The 60th Anniversary—A Time for Review

The year 1965 marked the 60th anniversary of the establishment of the Forest Service in the Department of Agriculture. From its founding, the Forest Service was dedicated to the basic principle of multiple use management of the Nation's forest resources. As the Nation grew in population and industrialization, use of the forest resources for timber products, forage, wildlife, water, and recreation became more intensive and increasingly essential to the support and enhancement of the Nation's economy. The need for a comprehensive program of research became apparent. Congress was becoming more aware of the necessity for increased funding and with the 10-year program, now in its 4th year, appropriation increases gathered momentum. The Pacific Northwest Station shared, and allotments for F.Y. 1966 were nearly 30 percent greater than allotments for F.Y. 1965, totaling $2,638 million, practically all specified for research projects. Major increases were given timber management, watershed management, forest insect, forest disease, and forest products utilization research projects. Increases for these two fiscal years made possible addition to the staff of scientists, technicians, and other supporting personnel during calendar year 1965 and extending into 1966.

Improvements in Personnel Policies and Practice

Recruitment of topflight scientists was made easier by three new developments in Civil Service principles and practices. Congress adopted the principle of comparability of Federal employee salaries with persons in private employment. In recent years, they totally adopted the man-in-job concept of classification; scientists no longer had to supervise to advance in grade; and the Commission also established a special higher classification for scientists of unusual skill and stature, the so-called supergrade category. Although this improvement in the status of Federal scientists was a progressive step, the increased cost for resulting salaries, coupled with inflationary increases in supplies and travel, had an adverse effect of diluting some of the increased allotments. Partly offsetting this factor was the increased ability to employ more technicians, relieving scientists of many routine and tedious tasks. Technical assistants increased in number from 11 in 1964 to 20 in 1965,almost doubling this important aid to project progress. However, considering that the Station had more than 100 scientists on its staff at that time, the ratio of 1 to 5 was far from the optimums: On the other hand, recent measures taken to improve research environment not only increased availability of a pool of competent technical aides but, of greater importance, increased research effectiveness overall. For example, locating project headquarters on or near campuses of higher education institutions gave Station scientists access to opportunities for additional training and retraining personnel programs and other academic amenities. Another move by the Station to further this major objective was to group scientists of complementing skills. An example was to concentrate wildlife habitat studies at La Grande, Oregon.

Station Reorganizing Completed

Finally, the Station reorganization, underway for several years, was accomplished with the consolidation of research functions into four groups, each headed by an assistant director as follows: Timber Management and Forest Fire Research, George S. Meagher Watershed Management, Forest Recreation, Range Management and Wildlife Habitat Research, Robert W. Harris; Forest Insect and Disease Research, Robert L. Furniss; and Forest Economics, Forest Products, Marketing, and Utilization and Engineering Research, Carl A. Newport. Business management and other supporting services, with the exception of biometrics, formed a fifth group called Station Management under Charles J. Petersen, assistant director. Harris, who served in the latter capacity during a critical period of the Station's growth and development, returned to a research position, his first and major career interest and one for which he was particularly well qualified and experienced.

Research studies were grouped under 29 line projects, each under the direction of a project leader. Three former division chiefs—Childs, Forest Disease Research; Grantham, Forest Products Utilization Research; and Bruce, Forest Fire Research—returned to primary research as project leaders. Former center leaders also became project leaders and some projects were put in charge of personnel recently added to the staff.

Forest Protection Research Stimulated

During the past 2 years, forest protection research projects in particular benefited by increased funds; the improved laboratory facilities and the reorientation of study programs at this Station and neighboring Stations and through increased strength of cooperating agencies. The insecticide evaluation program which had been assigned to the Pacific Southwest Station allowed this Station to concentrate efforts on studies directed toward biological and silvicultural control of forest insects.

The insecticide evaluation program was financed at approximately half a million dollars annually with allotments from Research and Pest Control funds. New laboratory facilities were established at Berkeley and a mobile laboratory put in operation, facilitating westernwide operation and cooperation with other agencies. Initially spruce budworm was the major experimental insect used; however, the Douglas-fir tussock moth, hemlock looper, chem-Pandora moth, and several other forest tree defoliators were also used in this important project aimed at testing chemicals in search for environmentally acceptable substitutes for DDT and other chlorinated hydrocarbons. Field tests were made with pyrethrium, Zectran, Durshan, and dibrom under plans to continue this program.

Main efforts in biological control of damaging forest insects were centered at Corvallis, where the westernwide forest insect disease project was headquartered under the leadership of Dr. Thompson. By 1965, the project staff had been increased to four scientists and six nonprofessional supporting personnel (some on a part-time basis). New additions to the project were Dr. Mauro E. Martigoni and Dr. Bohdan Maksymiuk; both of these scientists joined the Station in June 1965. Both applied and basic research work was underway by this unit and much of it had potential application in other fields. For example, studies of antimicrobial substances on tree foliage should lead to better understanding of genetic resistance to insect attacks.

Research on the virus of the Douglas-fir tussock moth was applied in nature. Like other pathogens, this virus had to be tested for safety and conformation to the requirements of the Food and Drug Administration.

Research on feasibility of eradicating the European pine shoot moth was also accelerated by additional allotment of pesticide-related funds in 1965.

The forest insect biology and ecology project under leadership of Kenneth H. Wright was headquartered at Portland in 1965, although one scientist was located at Corvallis. A major goal of this project being tackled in cooperation with the forest genetics project located in Corvallis was to develop trees resistant to insect attacks which would be a durable solution to a most critical insect problem.

The root diseases and soil microbiology project at Corvallis, led by Dr. J. M. Trappe, was staffed to pursue vigorously the potentials of biological control of root diseases in the forest. Three scientists—Zak, Nelson, and Lu—were assigned to this project in 1965 and two permanent technical assistants were employed. Three avenues of approach were available: (1) reduce vigor and extent of the pathogens; (2) favor soil organisms that physically protect roots or antagonize, parasitize, or compete with the pathogens; and (3) increase resistance of the host.

Pesticide Problems Given High Priority

A project named “Pesticides—Soil and Water” was activated late in 1964 and Robert Tarrant was placed in charge and moved from Portland to Corvallis where the project was headquartered. Dr. Duane G. Moore of the University of Hawaii and Dr. Walter B. Bollen of Oregon State University were added to the project staff. The principal assignment of this group was to determine how much pesticide applied to forest land was getting into the water resource, a question environmental groups and agencies were raising.

Work got underway in a study of the effects of spraying with DDT against the Douglas-fir tussock moth in 1965 on the Malheur National Forest in eastern Oregon. A cooperative aid study with the University of Washington was initiated on the movement of pesticides in the soil. Tarrant worked with the Berkeley insecticide evaluation project on nonpersistent pesticides; Zectran, for instance.

Expansion of these and the other Corvallis projects outran the available laboratory and office space at the Forest Science Laboratory. Although some laboratory space at the university was available, this institution also had growing pains. This pointed to the urgent need for completion of the construction planned for Corvallis. A similar situation existed at Olympia.

The animal damage control project was also growing. David Tackle transferred from the Intermountain Station to head this project. Others on the staff in 1965 were Radwan, Dimock, and Crouch; the latter was added to the Station staff in 1965, after receiving a Ph.D. degree from Oregon State University in 1964.

In the general field of forest protection, two forest fire projects were operating in 1965, both located in Seattle. These were fuel inventory systems, headed by George R. Fahnestock who transferred to the Station from the Southern Station in 1965. W. G. Morris was assigned to this project. The fire danger rating project was staffed by Don Flora, project leader, and James Hefner.

Timber Management Research Decentralized

Timber Management Research projects, nine in number, were fairly well distributed at field centers close to problem areas by 1965. The seeding, planting, and nursery practice project remained in Portland under Stein’s direction, assisted by Edgren, also working from the Portland headquarters, and Kenneth Krueger,[2] Stationed at Corvallis. Also located at Portland was one full-time technician. When laboratory and office space became available, it was planned to consolidate the entire group at Corvallis. During 1965 and for the previous 3 or 4 years, about half the time of this group was spent on nursery practice improvement studies and Stein and Krueger each had several publications in this field of study during 1965.

Other project work underway at this time included seedling photosynthetic characteristics, germination effect of hydrogen peroxide, improvement of noble fir seed quality, and mycorrhizal relationships of Northwest conifers. Trappe worked with this group on the latter study.

Two other timber management projects were entirely located at Corvallis: (1) breeding Northwestern trees, under Silen with two scientists assisting; and (2) silviculture of true fir-mountain hemlock and Sitka spruce-western hemlock types, with a staff consisting of Herman, Franklin, Minore, and Ruth, project leader.

2 Like a growing number of Station personnel, Ken Krueger was the son of a Forest Service forester.

Some of the recent findings of the genetics project were: (1) significant difference in yield from 50-year-old Douglas-fir families; (2) a surprising 30-40 percent of the Douglas-fir seed orchard grafts made to date had incompatibility problems; and (3) abortion of floral buds before differentiation was a major cause of cone crop failure.

Research on the silviculture of coastal forests had been underway several decades. A considerable amount of it was done at the Cascade Head Experimental Forest since establishment of this important research facility in 1934. The cooperative cutting agreement with the Publishers Paper Co. concluded in 1965. This arrangement facilitated many of the studies in spruce-hemlock silviculture and management at Cascade Head.

Plans were made to prepare a departmental publication describing silvical characteristics of these two species and current and recommended silvicultural practices. Studies in true fir-mountain hemlock did not get started until 1960, and then on a small scale owing to financial malnutrition. With recent increases in funds this neglect was expected to be remedied, particularly since one staff member, Jerry Franklin, had an intense interest in this type.

The Douglas-fir silviculture project, headquartered at Olympia under the leadership of Norman Worthington, assisted by two scientists, Reukema and Williamson, and a full-time technician, had been very productive in research results. As now constituted, it consisted of several closely related study areas concerned with management of precommercial and commercial stands, harvest cutting and regeneration, and studies to obtain basic knowledge to provide a rationale for the applied studies. A great deal of the past work had been on commercial thinnings, much of it with cooperators. Emphasis currently was directed to management of young stands of precommercial size.

Late in 1965, Norm Worthington retired after an outstanding career in timber management research in the South and Pacific Northwest. Eschewing the ivory tower approach, he had the faculty to inspire cooperation with other agencies, public and private, and find workable solutions of immediate problems for early application in practice.

Two timber management projects were headquartered at Roseburg, Oregon, each manned by a single scientist. These were silviculture of mixed pine-fir forests, W. E. Hallin, leader; and brushfield reclamation, Dr. H. J. Gratkowski, leader. There were many critical timber management problems in southwestern Oregon, mainly centering around holding forest lands in timber production and restoring underproductive lands to their full potential.

Timber management research on the east side of the Cascades was consolidated in one project, located at Bend, Oregon, and entitled, “silviculture of interior conifer types.” The staff of three—Dr. Carl Berntsen, project leader, Walter Dahms, and James Barrett—had a host of problems in need of answers. Laboratory and other housing facilities were more than adequate; urgent need was increased personnel. Past research in lodgepole pine proved that this conifer was capable of growth rates comparable to its better known associate, ponderosa pine.

Rigidly controlled experiments in stand density of ponderosa pine have shown extraordinary diameter and height increments of widely spaced saplings. If these initial results hold up, production of merchantable wood could increase greatly over that of current yield table predictions. This would mean a big boost to the timber economy of this forest region.

However, probably the greatest opportunity of the ponderosa pine region for satisfying future demands for wood lies in intensive management of the mixed species of the interior conifer types. One of the obvious problems is which species to favor in these forests involving mixtures of as many as five coniferous species. Preliminary to such a determination was enlarging silvicultural knowledge of the individual species and the complex interactions.

Also of vital importance to the eastside region of the two States is proper watershed management practices in timber harvesting of the interior conifer types. Climatic, edaphic, and topographic factors present many critical problems. The water yield and erosion project was staffed and equipped with laboratory and supporting facilities to produce answers to some of these urgent problems. Herbert W. Berndt transferred to the Pacific Northwest Station from the Rocky Mountain Forest and Range Experiment Station in December 1965 to head this project, filling out a staff of five scientists.

The watershed logging methods and streamflow project, headquartered at Corvallis in charge of Jack Rothacher assisted by Ted Dymess and Dick Fredriksen, produced some positive results from longtime studies on the Andrews Experimental Forest. For example, it was found that peak flows were not measurably increased by road construction, but suspended sediment increased and then declined. Neither did logging by block clearcutting or skyline (Wyssen) systems increase peak flows.

Flood conditions in December 1964 and January 1965 emphasized soil stability problems. Mass soil movements (slides) occurred throughout the Andrews forest, but 60 percent of the total slides greater than 100 cubic yards were associated with roads, 30 percent with clearcut areas, and only 10 percent in green timber.

Range and Game Management Research Centered at La Grande

The range ecology and management project, headed by George Garrison with a total staff of four scientists, was headquartered at La Grande, Oregon. This project was concerned with studies in the ecology and management of forest and related ranges in the Pacific Northwest, with emphasis on perennial bunchgrass vegetation. Also headquartered at La Grande was the big-game habitat project, emphasizing ecology and physiology of cover and forage and forest types and species. The staff of four, consisting of Justin G. Smith, project leader, Burt R. McConnell, J. Edward Dealy, and Paul J. Edgerton, were moved to La Grande from other locations, consolidating this work there. This created an urgent need for laboratory and office space but this would have to wait for appropriation of construction funds, which would mean several years in the future before a facility comparable to Bend or Wenatchee could be made available.

Completing the group of projects under the direction of Assistant Director Harris was the Wilderness Recreation Dynamics project, described in more detail as recreational use of wilderness type areas and requirements of recreation in relation to other forest uses. Harris acted as project leader from the time Wenger resigned early in 1965 to accept a position on the faculty of Syracuse University. John C. Hendee joined the Station in August of 1965 by transfer from the Pacific Southwest Station and was Stationed in Seattle where he would work with cooperators from the University of Washington faculty. At the same time, Hendee planned to commence a doctorate program at the university. John Hendee is the son of Clare Hendee, Deputy Chief of the Forest Service, making the third Forest Service father-son combination on the Station staff.

Economics, Utilization and Engineering Research Grouped

The group of seven projects in forest survey, forest economics, forest products, marketing and utilization, and engineering research was under the direction of Dr. Carl A. Newport, assistant director.

The forest survey project headed by Melvin Metcalf was the largest in numbers of full-time scientists, supplemented by a number of temporary field assistants and several full-time computers in the office. In addition, the survey techniques project, headed by Pope, had a full-time staff of two scientists. These two projects were headquartered in Portland, although the forest survey project was in the process of assuming responsibility for this work in the State of California.

The production economics project staff was increased during 1965 to four scientists. Dr. Con Schallau, the project leader, transferred to the Station from the Lake States Station early in 1965. Other staff members were Dr. Daniel Chappelle, who came from the Southeastern Station late in 1964, Brian Payne, a comparative old-timer on the project, and Robert Sassaman. The marketing project had a staff of three; Dr. John Beuter, project leader, Dr. Thomas Adams, and Dr. Thomas Hamilton.

Two projects were in the general field of products utilization research. One, regional utilization problems, had a staff of two: Jack Grantham, project leader, and Alexander Oviatt. The latter joined the Station as a principal research architect in August of 1965. A third man, Thomas B. Heebink, was scheduled to report to the Station in February 1966 by transfer from the Forest Products Laboratory at Madison, Wis. By that time, all three of the staff would be located at Seattle and would center research efforts on wood construction concepts. The wood quality project remained headquartered at Portland and in 1965 had a staff of five scientists headed by Paul Lane. Henley, Woodfin, Plank, and Levitan completed the staff. Levitan was a newcomer to the project, joining the staff in 1965.

The forest engineering project, staffed by Lysons, project leader, Mann, and Binkley, was firmly established in Seattle. Although in existence only 3 years, the need for engineering research had been well demonstrated across a wide range of forestry problems. Three phases of the balloon logging study had been completed and prospects were promising that this type of logging would be profitable on compatible settings.

1966—A Year of Many Changes

Progress continued to be made in forest research programs' in the Pacific Northwest in 1966. As in previous years, a major share of the Station's program was conducted in several forms of cooperative effort with the two States, the universities, the forest industries, the Bureau of Land Management, the Fish and Wildlife Service, the National Forests, and other public agencies.

Congress added considerably to this progress by providing funds in FY 1967, appropriations for construction of sorely needed laboratory facilities and for planning other laboratories scheduled for construction in the immediate future. With this money, construction of the Silviculture and Animal Problems Laboratory at Olympia commenced in November 1966. At the same time, work began on preparing plans and specifications for the Range and Wildlife Research Laboratory in La Grande and the second phase of the Forest Sciences Laboratory in Corvallis. In all, nearly $650,000 of construction funds was allotted to the Station in FY 1966, making the total funding for all Station activities over $4 million. However, the Station's area of responsibility and service was extended to include Alaska. During 1966, the Northern Forest Experiment Station (Alaska) was converted into the Institute of Northern Forestry Research. Studies were commenced to integrate the research programs of Alaska with those of the Pacific Northwest Station. In the meantime, support services of this Station, such as library, biometrical analysis, editing, and engineering, were given to the Alaska Institute. For some years in the past, forest products staffmen of the Pacific Northwest Station extended some activities to Alaska, and in other disciplines close relationships had been maintained.

A number of important personnel changes and moves occurred during 1966. Two significant losses of key staff members late in 1966 were the resignation of assistant director Carl A. Newport and the retirement of assistant director Robert L. Furniss. Dr. Newport resigned to join the staff of Mason, Bruce and Girard, a prominent consulting forestry firm. Dr. Donald Flora, currently leader of the forest fire rating project in Seattle, was named as his successor, although Flora would remain in Seattle until early 1967. Loss of Furniss was mitigated by his retention as an expert forest entomologist consultant to the Station, and the plan to use his encyclopedic knowledge and unflagging energy to revising the bulletin "Insect Enemies of Western Forests." One is tempted to say the Station's loss was a gain to all western forestry. His successor as assistant director was Kenneth Wright. The Station was singularly fortunate in filling highly important positions with extremely competent people from within the ranks. In another key move, Dr. Thomas (Toby) W. Childs was designated principal scientist and special consultant and assigned to the task of interpreting and helping put into practice 35 years of forest disease research by himself and other forest pathologists. Dr. Keith Shea, formerly of the Weyerhaeuser Co.'s forest management research staff, was added to the Station staff at Corvallis as leader of the project, Diseases Reducing Forest Production. Others on this project at Corvallis were Paul E. Aho and George M. Harvey, forest pathologists. Early in 1966, Dr. Richard E. Miller was transferred from Roseburg to fill the vacancy left by Worthington's retirement as project leader of silviculture of Douglas-fir. Miller's specialty was forest soils and on his new assignment he gave special attention to studies in Douglas-fir nutrition and use of fertilizer.

In another move, Hubert D. Burke transferred from the Rocky Mountain Station in July 1966 to this Station as principal recreation specialist. He was assigned to head research on impacts on use of forest wilderness and was Stationed at Wenatchee.

The Station had an imposing list of publications issued in 1966. Numbering over a hundred, they covered a wide range of subjects and authors. Conspicuous on the list were the names of a number of cooperators who were coauthors with Station personnel.

Cooperators Assist Stations Programs

Among the highlights of 1966 was a pilot trial test of the new approach to breeding for improved Douglas-fir based on Silen's studies of performance on the 50-year-old heredity plots. The pilot tests were installed on the Stamm Tree Farm in cooperation with the Crown Zellerback Corp.

Another sample of benefits from cooperative efforts was the study of a Skagit Bullet skyline crane thinning operation in 110-year-old Douglas-fir, done with help from the Weyerhaeuser Co. Results indicated a solution to the problem of how to thin on steep ground. Damage to the residual stand was insignificant during reduction by 24 percent of the basal area.

Studies of effects of shelterwood cutting in the coastal forest types underway at Cascade Head for several years showed some interesting results. Recent observations of first-season growth of Sitka spruce, western hemlock, Douglas-fir, and red alder under a shelterwood canopy showed all three species were tolerant of shade during their first year.

Tests of the systemic properties of tetramine as a potential protection of forest tree seedlings against animal injury gave discouraging results. Three plant species—Douglas-fir, blackberry, and orchard grass—were studied by the Olympia group. Although this chemical was absorbed from nutrient solution by all three species, it did not recirculate within the plants; neither did it move downward after foliar application to mature leaves. In consideration of the extreme toxicity of tetramine, long a controversial chemical, to animals and humans, its future use in forestry appeared doubtful.

Integrated field and laboratory studies of the silviculture of lodgepole pine at the Bend laboratory showed that seedlings of this species are more cold resistant than those of ponderosa pine. This information helps forest managers in identifying sites that should be devoted to culture of lodgepole pine.

New and more refined guidelines for broadcast burning of clearcut areas in the Douglas-fir region were issued in 1966. These were based upon observations made in 1963 and 1964 of burned tracts on six westside National Forests.

Growing forest trees as a class use less than 5 percent of the water taken in; the remainder, more than 95 percent, evaporates. However, this varies among different tree species. Preliminary studies at the Wenatchee Hydrology Laboratory showed that as water becomes scarce, ponderosa pine and lodgepole pine conserve water better than Douglas-fir.

Sampling and analysis of a year's precipitation in an open area on the Cascade Head Experimental Forest showed that very little nitrogen is brought into a coastal Oregon forest ecosystem in precipitation.

Starkey Cattle Grazing Study Completed

The 13-year study of cattle grazing under three rates of stocking and two grazing management systems was completed. Preliminary analysis of results showed maximum gains per head of cattle were obtained under light stocking. No distinction was found between grazing systems, although in terms of watershed cover deferred rotation proved superior to season-long grazing.

Studies in eastern Washington on the Methow Game Range and in central Oregon on the Pringle Falls Experimental Forest showed that thinning stands of suppressed ponderosa pine saplings gave significant benefits to both livestock and wildlife.

Mountain pine beetle was causing increasing and extensive mortality in immature ponderosa pine stands. A study begun in 1965 indicated that regulating stand density by thinning may be an important factor in control of such beetle losses.

Development of methods for mass production of the nucleopolyhedrosis virus for biological control of the Douglas-fir tussock moth paved the way for experimental operational testing. Toxicological testing was being carried out to satisfy Food and Drug Administration requirements. This step completed, field tests could be made whenever the next suitable outbreak of this damaging pest occurred.

Methods of producing European pine shoot moths in large quantities were developed, a necessary step in testing the sterile male technique as a control method for this foreign insect invader. The work was done jointly by Washington State and Station research entomologists.

Studies of the ability of red alder to improve soil fertility by nitrogen-fixing root nodules were examined to determine if this could help in biological control of *Poria weirii.*

Forest Survey Aids Long Range Planning

Increasing interest in long-range regional planning of natural resource development and protection by both public and private agencies made heavy demands upon the forest survey staff and data bank.

Willamette River Basin and for the Puget Sound and adjacent water basins. Such analyses were made easier by the recently developed stand table growth projection method, known as TRAS. It was used for updating forest survey inventory statistics predicting future timber supplies and exploring various timber management alternatives. July 1, 1966, administrative control of forest survey activities in California was transferred to the Pacific Northwest Station from the Pacific Southwest Station. Two full-time professional staff, Daniel D. Oswald and Gerhard F. Muerle, were moved to the rolls of this Station but remained in residence at the Berkeley Station.

The production economics staff started a study of timber management planning systems in cooperation with Region 6 staff members in 1965. The purpose of this undertaking (named TIMADS in the alphabetical vernacular) was to develop mathematical models and computer programs by which decisionmakers can better analyze timber management alternatives on National Forests. In view of the dominant role of the National Forests as a source of timber in this region, administrators must know and understand consequences of various decisions regarding forest resource use.

A new system which predicts the value of inland Douglas-fir when manufactured into lumber was developed during the year by the Station's wood quality research staff. This simplified and improved accuracy of timber cruising and facilitated computation of cruise data.

A highlight of the Station's forest engineering research in 1965 was an operational test of balloon logging begun at Deception Creek on the Willamette National Forest. Assistance of cooperators were a big help in this test.

Staff of the Station's wood construction project in Seattle began a field study in 1965 to determine the moisture content of heavy structural glue-lam members under varied service conditions. This project was national in scope and initiated by the Forest Products Laboratory at Madison, Wisconsin. Regional data gathered by this Station and that gathered from other regions were to be combined and analyzed by the Madison Laboratory.

Increased Funds Accompanied by Organization and Personnel Changes

Progress in producing much needed research results continued to be made during 1967. On the other hand, pressures on our forest and related rangeland resources more than kept pace with this progress as increased populations continued to expand demands for forest products, worldwide as well as regional. Consequently, problems in the Station's area of responsibility grew at a great rate in scope and complexity.

Additional funds provided by Congress and progress in improving research facilities enlarged the Station's capacity to meet these challenges. Appropriations for FY 1968 increased to about $4.35 million. However, allotments for this and the previous year included funds for Alaska research programs, now under the Station's responsibility and full administrative control. Increases permitted strengthening a number of high-priority projects at the Station; forest fire research, forest recreation, forest engineering, economics, watershed management east of the Cascade Range, and forest genetics research. A number of personnel changes occurred during 1967, some resulting from fund increases and others from retirements, transfers, and promotions. Also, there was some reshuffling and renaming of projects to better describe expanding field of study subject matter.

Fire studies were moved from the timber management group to an expanded grouping of projects called “Forest Protection Research;” this also included forest insect and forest disease research. Kenneth H. Wright was promoted from project leader to assistant director heading this group. Dr. James L. Murphy transferred from the Pacific Southwest Station to head a new project, Cooperative Forest Fire Science, located in Seattle at the University of Washington. A principal objective of this new project was to assist the University’s College of Forest Resources develop graduate programs in forest fire research. Another objective was to stimulate strong cooperative research programs in forest fire behavior, control, and use. The Fire-Danger Rating project was closed out in Seattle and transferred to the Rocky Mountain Station at Fort Collins, Colorado.

Retirement of Bill Hallin during the year was followed by the consolidation of his project, Silviculture of Mixed Pine-Fir Forests at Roseburg with the Silviculture project at Corvallis, headed by Ruth. The consolidated project was named “Culture of Mixed-Conifer Forests, West-Side Cascades.”

Transfer of Dr. Carl Berntsen to the Washington Office, Timber Management staff, led to the promotion of Dahms to leadership of the Culture of Interior Coniferous Forests project at Bend. Patrick Cochran, soil scientist, was added to the staff of that project. He formerly held a teaching and research position at the New York State College of Forestry at Syracuse.

Dr. Boyd Wickman transferred from the Pacific Southwest Station as leader of Forest Insects of the Pacific Northwest project, a position vacated by the promotion of Ken Wright. Richard Miller succeeded Worthington as leader of the Douglas-fir project at Olympia, moving from Roseburg. John Hendee, armed with a Ph.D. degree from the University of Washington, returned to full-time duty as project leader of the Wild-Land Recreation project at Seattle, after several years of part-time educational leave.

Colin MacLean rejoined the Survey Techniques Project after a 4-year assignment in Napal with the Agency for International Development. On the other side of the world, Jim Trappe started a year of European study and research on the large group of root fungi, the *Tuberales*. Most of the work was to be centered at Turin, Italy, working with Professor Arturo Ceruti, a famous authority. Robert Campbell, formerly with the Weyerhaeuser Co. research staff, joined the Station as principal plant geneticist on the Breeding Northwest Trees project in Corvallis.

The Forest Engineering Systems project in Seattle was strengthened by recruitment of two mechanical engineers, Ward Carson and Joseph Mulcahey; Carl Vigna, an industrial designer; and John Barton, a physicist. The Timber Quality project also gained a professional staff member in 1967, Wee Yuey Pong, associate wood technologist.

Institute of Northern Forestry Joins Station

In point of numbers and importance was the addition of the Institute of Northern Forestry, located at Juneau, Alaska, and its staff headed by Richard M. Hurd, director, to this Station’s expanding staff of scientists. The Institute had a total of seven projects manned by 17 professionals. Four projects were located at Juneau; Culture of Coastal Forests—Alaska, A. S. Harris, leader; Erosion and Sediment Reduction—Alaska Coastal Forests, A. E. Helmers, leader; Forest Insects—Coastal Alaska, D. C. Schmiege, leader; and Forest Survey—Alaska, O. K. Hutchison, leader. Located at the College of Alaska, Fairbanks, were three projects: Ecology of Subarctic Trees and Forests, R. A. Q Geogory, leader; Fire Control Methods—Alaska, R. J. Barney, leader; and Forest Insects—Interior Alaska, L. C. Beckwith, leader.

Prominent in the Station's list of publications for 1967 was "Alaska's Forest Resource," U.S.F.S. Resource Bulletin PNW-19, by O. Keith Hutchison. This bulletin gave the completed results of the inventory of Alaska' forest resource, begun in 1954. For a number of years, fieldwork was on a small scale and confined to the more accessible areas. With improvement of aerial survey techniques and increased availability of funds, the survey was extended to cover the entire State. It found that Alaska had 119 million acres of forest land or 16 percent of the Nation's total. However, only 28.2 million acres could be classed as commercial for timber production. Sawtimber volume was estimated at 215.5 billion board feet, a sizable figure by any standard of comparison. Eighty percent of this volume was western hemlock and Sitka spruce in the humid coastal region.

Marketing research was expanded to include Alaska and information was gathered to define forest products marketing problems of that State.

Station support services were strengthened by establishment of a new position, information officer. It was filled by Charles Newlon.

The Olympia Forest Sciences laboratory was completed in November and occupied in December 1967. In September, the construction contract was awarded for the La Grande Range and Wildlife Habitat Laboratory. It is located on a 4-acre site leased from the Eastern Oregon College of Education. Plans for the second phase of the Corvallis Forestry Sciences Laboratory were completed about midyear.

The Station's Forest Survey project, with responsibility for all four Pacific Coast States, which contain the build of the Nation's commercial timber resource, has a tremendous job of keeping data current for analyses of many kinds of forest resource situations and problems. For example, during 1967, the Station's survey staff was completing analyses of the timber resources and the forest industries in the frame of long-term national demands for wood products for two major river basins, the Columbia North Pacific and the California.

Timber Measurement Problems Studied

One of the most pervasive and persistent problems in Forest Science studies is basic timber measurements. The board-foot unit had been under criticism for many years owing to its many vagaries. Even the cubic-foot unit had its critics. In 1967, the Station commenced a special study of timber measurement problems in the Douglas-fir region where the problem was acute because of the wide range of size of standing trees and logs and the resulting considerable pecuniary values of timber products.

Quantity was not the only variable factor; measurement of quality was also a critical problem. The Timber Quality project was making encouraging progress as the staff grew and as study techniques improved. Currently it was estimated that the annual cut of commercial timber was to have a stumpage value of $500 million. When the additional values developing during the harvesting and processing steps to the market point are considered, the importance of quality measurement magnifies. The timber quality studies involve cooperation of many agencies in nearly every case. During 1967, the possibility of developing a quality classification system for Douglas-fir trees and logs based upon bark characteristics was commenced in cooperation with Oregon State University. Another study, done in cooperation with the University of Washington during 1967, was development of techniques for recording quality characteristics of logs and trees through photographing green veneer as it left the lathe. A third was a study with the University of California in the occurrence, cause, and effect of wetwood or blackheart, a defect common to white fir.

Analysis of Forest Survey plots in even-aged Douglas-fir disclosed some new information on the relationship of stand growth to stand density. It was found that as stand density increases, both gross and net cubic-foot growth rise at a relatively constant rate with no tendency to peak or level off. This apparently contradicts the long-held beliefs that over time stands trended towards normality and that there was a broad range of stand densities that produced essentially the same total growth.

Growth response of suppressed ponderosa pine saplings to thinning and removal of understory vegetation at Pringle Falls over the previous 8 years was dramatic. This indicated that time to produce usable-sized trees could be reduced and amount of wood of usable dimensions increased.

A 4-year study of effects of applying ammonium nitrate in a 35-year-old Douglas-fir plantation on site V lands showed marked and rapid growth response. This indicated that N fertilization might have high value as a silvicultural measure on N-deficient sites.

Release of young Douglas-fir from an overstory of varnishleaf ceanothus by mechanical and chemical means appreciably increased height growth in southwestern Oregon.

Harvest of all merchantable timber from a small experimental watershed in western Oregon increased the water yield more than 40 percent and, more important, a portion of this increase came during the lowest flow period when streamflow was in peak demand for consumptive use and for stream pollution abatement.

A 17-year study of the effects of timber harvesting on salmon streams in southeast Alaska led to the conclusion that harvesting, carefully done, was compatible with salmon production.

Station hydrologists at Wenatchee found that winter frost or rime contributed nearly 2 inches of water during the 1966-67 winter on a study area at 6,000-foot elevation on the east slope of the Cascades. This indicates that winter frost not measurable by ordinary methods increases water supply for forest vegetation and downstream consumption.

It was determined that aerial color photography showed promise for estimating height and density of understory vegetation, two important determinants of forest fire behavior. Perfection of this technique would do much to make possible rapid appraisal and mapping of fuel types over large areas where basic fuels are obscured by the forest canopy.

Methods were developed for estimating numbers of eggs and larvae of the Douglas-fir tussock moth at low and high population levels. With such information it is possible to determine when control measures are needed. During 1967, safety tests of an important virus of the tussock moth were encouraging.

It was estimated that the annual disease impact on forest productivity in Oregon and Washington amounted to 403 million board feet or the equivalent of 3.1 billion board feet. Analysis of loss by cause and type was used to establish research priorities. Growth loss was the largest item and dwarfmistletoe the greatest offender, followed by root rots and heart rot.

A soil survey of a *Poria weirii* root rot area turned up five new principal fungi antagonists of *Poria.* This was a positive step in finding biological control of *Poria* through encouraging these antagonists by regulating ecological conditions.

The Starkey grazing management study continued to yield important results as analysis of data gathered over 11 years showed. Summer grazing at 20, 30, and 40 acres per cow and calf reduced elk sedge, an important forage plant for game animals and livestock, 20, 14, and 6 pounds per acre. Losses in elk sedge production were noticeably greater under season-long grazing than under the deferred-rotation system. With this information forest rangeland managers can plan distribution practices to obtain increased use of ponderosa pine land forage such as elk sedge.

It was learned that protection of bitterbrush planting on deer winter ranges until plants mature and release plants from competing vegetation produced a striking gain of 80 pounds per acre.

Time Brings Many Personnel Changes: Childs and Meagher Retire

With a roster of 152 scientists at the Station in 1968, it was not surprising that new people joined the Station and others whose names appeared many times in the Station's past history were removed from the rolls. The untimely death of Dr. Kenneth W. Krueger in July was a great loss to his associates and many other friends. Ken was the son of Carl Krueger, for many years forest supervisor of the Coeur d'Alene National Forest in Region 1 of the Forest Service. He joined the Station in 1957 from the University of Idaho and specialized in forest disease research first and later in timber management research. In his comparatively short career he showed great promise. The Station lost two top scientists through retirement after long and notable careers in forest research. Dr. Thomas W. Childs, a leading authority on *Poria weirii,* root rot of Douglas-fir, retired in January 1968, after 39 years with the Department of Agriculture. George S. Meagher, assistant director of Timber Management Research, retired March 1968. George commenced his career in forest research at this Station in 1935, following graduation from University of Washington in 1934 and a year of graduate study at Cornell University. David Tackle was promoted to the position of assistant director, Timber Management, vice Meagher. Dr. Glen L. Crouch became project leader of the Animal Damage Control project at Olympia.

Dr. J. Alan Wagar transferred from the Intermountain Station to head the newly established Cooperative Forest Recreation project at the University of Washington, Seattle. Dr. John O. Klock joined the Water Yield Improvement and Erosion eastside project at Wenatchee. Dr. Klock was a 1968 graduate in soil physics at Oregon State University. Dr. Jon M. Geist, also a soil scientist who received his training at Colorado State University, was added to the Range Environmental Ecology project at La Grande. Dr. Geist's undergraduate training was in forestry and range management. The staff of the La Grande project typifies the interdisciplinary teams the Station was building to tackle complex problems in an integrated approach instead of by piecemeal attacks.

Dr. Donald M. Knutson was added to the staff of the Diseases Reducing Forest Production project at Corvallis. He concentrated chiefly on dwarfmistletoe of conifers.

Dr. Dennis L. Schweitzer transferred from the North Central Experiment Station to the Evaluation of Timber Growing Opportunities and Forestry Programs, Pacific Coast project at this Station. Dr. Thomas E. Hamilton was named project leader for the Methods of Marketing Forest Resources project, replacing Dr. John Beuter who entered private forestry consulting work, later joining the Oregon State University faculty.

Dr. John C. Zasada joined the Ecology of Subarctic Trees and Forests project at the Station's Institute of Northwest Forestry. Dr. Zasada is another second-generation Federal forest research forester to join the Station. His father "Zig" Zasada had a long career in Forest Research at other Stations. John's specialty is tree physiology and tree-soil-water relationships.

Two new research laboratories were dedicated and occupied in 1968. The Forestry Sciences Laboratory near Olympia was dedicated in April. It occupies a 10-acre site leased from the Washington State Department of Natural Resources. The La Grande Range and Wildlife Habitat Laboratory at La Grande was dedicated in November. The building emphasizes contemporary uses of wood products grown in the Pacific Northwest.

The Station's research program had expanded to cover a wide range of problems in depth based upon improvement of research facilities, a larger staff of highly trained scientists and a large group of cooperators, including academic institutions, private research foundations, forest industries, and other government agencies. The Station's Annual Report for 1968 emphasized the wide scope of its research activities by giving examples of such cooperators.

The problem of logging residues was reexamined during 1968. Periodically for about four decades, public attention has been called to the vast quantities of wood fiber unutilized in the logging and timber manufacturing operations in the Pacific Northwest, particularly in the Douglas-fir region. Growth of the kraft pulp and fiberboard industries had greatly reduced the quantities of mill residues over the years until it was no longer a significant source of potentially usable wood fiber. However, in 1968, it was estimated that in Oregon and Washington, logging created 23.5 million tons of coarse residues and 15.9 million tons of finer slash each year. Most of this material occurred on clearcuts in the Douglas-fir region. In addition, 7 million tons of slash was burned each year to reduce the fire hazard and prepare the forest site for regeneration. Slash burning was coming under attack as a source of air pollution as environmental issues became widely publicized. The benefits of slash burning were not generally understood by the public. The Station judged the time was appropriate for an expanded program of research to show the way for maximum use of logging residues with optimum effect on timber management and the total environment. Plans were made to put such work in action.

At the same time, 1968, log exports reached a new high with a volume of 2.0 million board feet. This factor helped promote better utilization of the total timber stand in the Douglas-fir region. Other economics research contributed to better management in the timber economy. For example, an economic analysis of public forest investment opportunities in the Douglas-fir region showed a wide variation in returns between working circles. The data also indicated that areas where nontimber values, recreation, water, esthetics, etc., are greatest would not yield very high returns on investment in timber production. A computer program, known as SORAC, was developed by the Production Economics staff for calculating allowable cut by use of either area or volume regulation for a series of planning periods. Although it was designed for analyzing National Forest management alternatives, it was applicable to any forest resource management situation. It enabled the user to introduce growth and yield expectations for every planning period.

Analysis of growth and yield data from spacing test plantations established in 1925 on site IV lands at Wind River showed growth had been greater on wider spacings and differences were increasing with time. Spacing studies of ponderosa pine at Pringle Falls also showed that progressively wider spacing steadily increased individual tree growth. The ponderosa pine study demonstrated that intensive land management can harmonize wood, water, and forage output in relation to demand.

Forest Genetics Covers Wide Field

The forest geneticists at Corvallis studying the inheritance of slenderness concluded, subject to further testing, that some of the control over tree diameter commonly attributed to spacing was actually of genetic nature. Dr. Sorensen, in another genetics study conducted in cooperation with scientists from the University of Washington and the Department of Natural Resources, searched for Douglas-fir trees carrying the albinism gene. Two unrelated trees that carry that gene were located, one near Lacomb, Oregon, and one near Corvallis. This discovery culminated a 4-year search by the group of cooperators and provided for the first time a valuable tool for directly estimating the amount of pollen exchanged among trees within seed orchards. Another study to learn how to minimize genetic contamination in seed orchards from outside sources found that a cold water spray at an appropriate time reduces pollen contamination.

Although black cottonwood *(Populus trichocarpa)* and balsam poplar *(Populus Balsamifera)* which occur extensively in Alaska were currently little utilized, they represented a potential timber source for industrial use. To learn more about these two closely related species, a study was commenced of hybridization between them.

Solution of a persistent problem in forestry, verification of seed source, was advanced greatly in 1968 for noble and Shasta red fir, two important species of the Cascade Range upper elevations.

Another comparatively little known but valuable timber species of Alaska, which also occurs to a limited extent in the Pacific Northwest, is Alaska cedar *(Chamaecyparis nootkatensis).* As a step towards better management of this species, an extensive search of its literature was completed in 1968 and a bibliography of over 300 references was published.

Study of aerial water-dropping as a potential alternative to chemical fire retardant in Alaska gave encouraging results. Use of aerially applied retardants in interior Alaska where forest and range fires have caused heavy losses is costly. On the other hand, numerous sources of water occur in this area for use in helicopter water dropping.

Well-stocked young ponderosa pine stands treated by precommercial thinning to a 12x12-foot spacing without slash disposal after felling retain a high rate of fire spread and resistance to control for at least 5 years. Observations on 2,000 acres of precommercial thinning included in the 25,000-acre 1968 burn on the Wenatchee National Forest confirmed this fact. This presented a dilemma: high fire hazard or serious loss of forest productivity. To help forest managers reach a decision, the Station presented a useful new means for evaluating the fire hazard factor in the Station Paper PNW-57 by George Fahnestock.

Gains Made in Basics of Forest Pests Behavior

Severe local damage to ponderosa pine forests on the east side of the Cascades occurs intermittently from *Elytroderma* (pine) needle cast. Station studies showed that growth rates are reduced in proportion to crown damage. Other information on the nature of needle cast occurrence and damage and remedial measures was being collected and assembled during 1968 for early publication.

Laboratory tests showed that 9 out of 25 phenolic compounds common in plants inhibited *Poria weirii.* This finding suggested that resistance of Douglas-fir roots to *Poria* could be increased by increasing their levels of such inhibitory compounds through genetic or physiological methods.

Development of basic concepts and techniques for classifying mycorrhizae overcame the difficulty of identifying the numerous types that occur in nature. Application of this knowledge by Station scientists at Corvallis to Douglas-fir was expected to advance biological control of root diseases.

A needle-mining midge *(Contarinia pseudotsuga)* seriously damaged Douglas-fir Christmas tree plantations near Corvallis. Studies of this insect attack pattern showed that amount of damage decreased significantly with lateness of bud burst. Selection of plantation stock from ecotypes or individual parents with late bud bursting characteristics was expected to reduce damage from this insect without resorting to chemical control.

As methods of controlling forest insects became more sophisticated, thorough knowledge of insect behavior became more demanding. An example is the liberation of European pine shoot moth males. The Station acted in cooperation with Washington State University in this field test. In preparation, the Station studied certain aspects of pine shoot moth behavior. It was found that in nature, wild males appear ahead of females. Using this information, scientists released sterile males slightly ahead of the emergence of wild males, giving them an advantage in seeking females.

One of the problems in microbial biological control of forest insects was freedom from contaminating bacteria in preparing specific virus inclusion bodies. In studying a virus disease of the Douglas-fir tussock moth, the Corvallis Forestry Sciences Laboratory produced pure virus inclusion bodies in large quantities. A gradient centrifugation technique developed at the Laboratory and centrifuge rotors developed at the Oak Ridge National Laboratory were used in this achievement.

Silvicultural insect control measures still have a place despite development of sophisticated chemical and micro-biological methods. A Station study determined that Douglas-fir mortality in young-growth stands, 70 to 150 years old, may be reduced as much as 60 percent through thinning based upon observations over a long period. Experience of the study plots through the 1952 and 1968 bark beetle epidemics indicated that thinning was more advantageous than sanitation salvage cutting.

Disease and insects are not the only biotic adverse agents the forester must learn to control. Many mammals also cause considerable damage. A recent survey showed that pocket gophers and porcupines ranked second to deer in damaging young trees.

Studies at the Olympia center refuted a long-held belief that nursery stock was browsed and clipped by wildlife more than natural seedlings. These studies show this to be doubtful and that the reverse may be true, at least for a short period after planting.

Wildlife habitat studies at La Grande showed that eastern Oregon deer and elk preferred to feed in the open forest. Seasonal food preferences and abundance were rated on a deer-elk range. Open forest rated highest in all seasons, due chiefly to an abundance of elk sedge, a preferred grasslike plant.

A low-level background of persistent pesticides was found in many parts of Pacific Northwest forest environment. Dust and rainwater are the most likely agents by which such chemicals are transported to other parts of the forest from point of original application. Studies at the Andrews Experimental Forest in the 1967-68 rainy season showed DDT present in low concentration but sufficient to account for much of the DDT background observations. The highest concentration was found in the first fall rains.

Water pollution is one of the chief concerns about the use of forest pesticides.

In a study of a small watershed in which woody vegetation had been controlled with 2,4-D in August, appreciable quantities of 2,4-D were found in surface runoff from the first fall storm which occurred at mid-September. However, by the end of October, level of 2,4-D in runoff from subsequent storms had fallen below limits of detection.

The principal cause of high stream temperature in western Oregon was found to be exposure to direct solar radiation. Streamside vegetation provides shade which greatly reduces net solar radiation on sunny days. Streamside vegetation may be controlled by forest managers during harvesting operations, thus helping maintain a favorable habitat for salmon, steelhead, and trout, which are cool-water fishes.

Timber and recreation values of flood plains, swamps, and reservoir shorelines may be increased by growing flood tolerant trees. To enlarge knowledge of such species, studies were made of six species by artificially flooding test seedlings. Western redcedar and lodgepole pine appeared to be most tolerant. Red Alder, Sitka spruce, and western hemlock were moderately tolerant, and Douglas-fir was intolerant.

Porosity is a soil property important to watershed managers. It determines the capability of a soil to receive, transmit, and store water. The Station developed an air pycnometer to measure soil samples for porosity features as an aid to management of forest and range soils. This instrument received wide attention, and other scientists used a model of it as a pattern for developing instruments suitable for similar problems in resource management and research.

The Forest Engineering Research staff studied the steps required for planning efficient single-span skylines in response to renewed interest in skyline logging. Results were published in USDA Forest Service Paper PNW-66, entitled “Planning Single-Span Skylines,” by Virgil Binkley and Hilton Lysons, 1968.

The Timber quality staff spread their activities eastward in 1968 in a study of the quality characteristics of ponderosa pine in the South Dakota Black Hills as related to yield of veneer. This study was initiated to determine the feasibility of establishing a plywood plant in that area and was done in cooperation with National Forest Administration and the local timber industry.

Studies of log quality in Douglas-fir included the downgrade effects of spiral grain and roughness. Extensive sampling of spiral grain patterns in coastal Douglas-fir showed a need to revise log grade systems that use spirality as a criterion. The “roughness” study showed that log scalers were often making excessive deductions for this defect. As a result, the “rough cut” deduction in log scaling and grading rules was improved and clarified.

The results of the Station’s study of the influence of design in the performance of wood conducted on buildings in the Puget Sound area was completed and results published. Grantham and his staff participated in a National Forest survey of moisture content of heavy glulam structural timbers in a variety of use environments. An initial report of the findings covering the first 2 years was also issued by the Station.

The Station’s annual report for 1969 commented that “ecology” and “environment” became household words and public concern with their deteriorated surroundings was becoming more vocal. As this report and reports for preceding years show, ecology and environment are bywords for forest research scientists who have studied forest, range, wildlife habitat and watershed problems for well over half a century in the Pacific Northwest. In 1969 alone, the Station issued 184 publications giving the results of its research projects which contain many recommendations for practices which would improve the forest environment when applied. However, the general public was little acquainted with the programs and objectives of the Station much less the scientific publications it issues each year. In order to better capture public attention and inform them of what forest research is all about and how it can contribute to solution of ecological and environmental problems, a weekly 5-minute radio program was initiated by the Station, sparked by Charles Newton. It capsulized a single piece of research and its application to an easily understood problem. It was broadcast over 45 Stations through Oregon, Washington, and Alaska, including one in Nome, Alaska, and one at Ashland, Oregon, on the California border.

The 1969 annual report also featured research natural areas, ecological showplaces and study areas where nature proceeds undisturbed by man. At the beginning of 1969, there were 41 research natural areas in Oregon and Washington, covering 27,254 acres, and 12 in Alaska, covering 220,308 acres. The list included areas established and protected by the Forest Service, Bureau of Land Management, Bureau of Sport Fisheries and Wildlife, and National Park Service, although the great majority were located on the National Forests. The oldest of the natural areas was the Wind River in western Washington. It was formally established in 1934, although as noted earlier in this history, it was informally set aside a number of years prior to that date through the efforts and foresight of Thornton Munger.

Although fiscal year 1969 appropriations were slightly less than those for the previous year, a substantial increase was granted by Congress for FY 1970, when the total was nearly $5 million. However, half a million dollars were earmarked for construction of a service building and a structural backfill at the Forestry Sciences Laboratory in Corvallis. Some increases in program funds were made available in the form of modest increases for all functions, except wildlife habitat and forest insect research, which received more generous amounts.

With financing assured, one new research unit was organized and located at Corvallis. It was “Aerial Application of Biological Agents and Other Materials.” Its purpose was to develop new technology for safe and efficient application of insecticides. This group was conceived to act as a coordinator between (1) the insecticide screening project at Berkeley; (2) the Equipment Development Center at Missoula, Montana; and (3) two projects at Corvallis, Behavior and Impact of Forest Chemicals and Diseases of Western Forest Insects. Staffing of the unit was commenced in 1970.

Despite the relatively large increase in funds for the La Grande Wildlife Habitat project, no additional permanent personnel were added. For some time in the past, this project was underfinanced, and maintained its staff of four scientists through salary savings at La Grande accumulating from assignment of Jon Skovlin to the FAO for a 3-year (1968, 1969, 1970) mission to Africa. The 1970 increase permitted installation of much needed study facilities and greater use of technical assistants by the wildlife project.

Other important staff changes took place during 1969. William G. Morris, forest fuels scientist, retired in November after 39 years of service at this Station. Bill was the author of more than 50 scientific publications on forest fire danger. In addition to his many contributions to Forest Fire Research, Bill carried on phenological observations on Portland flora on his daily walk to and from the Station.

Edith P. Tomkins, assistant editor, retired in October 1969. Edith Parmetter joined the Station October 1929 as a clerk stenographer and became the first official secretary to the Director in 1930. She enjoyed the distinction of being one of the few people in the Station who could read Director Munger's handwriting. She resigned in 1935 to become Mrs. Paul Tomkins. She returned to the Forest Service in 1948 in the Divisions of Operation and I&E, transferring to the Station editor's office in 1958. After retirement she did editorial consulting work for the Station and was of great assistance to the author of this history by typing and editorially correcting his manuscript, no easy task. As these lines are being written, it was learned that Edith P. Tomkins is starting a new career—painting nudes.

Several additions to the professional staff occurred during the year. Dr. Ching Yan Li, a native of Taiwan who received a Ph.D. from Oregon State University in 1969, became a member of the Western Root Diseases and Soil Microbiology unit at the Corvallis Laboratory.

Dr. Peyton W. (Pete) Owston replaced Ken Krueger in Seeding, Planting, and Nursery Practice research at Corvallis. Pete, who received a Ph.D. from University of Michigan in 1967, transferred from the Pacific Southwest Station at Berkeley.

Dr. Ronald E. Stewart, forest ecologist, another 1969 Oregon State University Ph.D., joined the Station's Brushfield Reclamation project at Roseburg. Dr. Kenneth W. Seidel joined the staff at the Bend Silviculture Laboratory, developing improved forest practices in eastern Oregon and Washington. Seidel came to the Station from the North Central Forest Experiment Station, where he had spent 11 years doing similar research in the Missouri Ozarks.

Dr. Arthur R. Tiedemann, a 1969 graduate in range ecology from the University of Arizona, joined the Water Yield and Erosion research unit at Wenatchee.

Penn A. Peters, aerospace engineer, joined the Forest Engineering Systems staff at Seattle to study the aerodynamics of tethered balloons for logging and the feasibility of new logging techniques.

Dramatic Changes in Station Program

The Station's research program altered dramatically in the quarter century since the end of World War II. Availability of new scientific technology and development of modern laboratory facilities provided the means for solving complex problems in greater depth. In turn, that required personnel highly trained in an increasing number of science disciplines. Fortunately, as shown by the character of additions to the professional staff of the late fifties and sixties, such people were available. The Station's policy of encouraging and aiding personnel on its rolls to undertake doctorate and post doctorate programs helped meet demands for specialized skills. More adequate salary scales were another factor in upgrading the quality of the staff in all aspects of the Station's work.

The passage by Congress late in 1969 of the National Environmental Act of 1970, after showing of public interest and legislative hearings and debates,[3] foretold far-reaching effect on many activities of the Forest Service, including forest research programs. It gave impetus to a number of research projects already underway, biological controls and forest chemicals as tools in forest management, for example.

Studies of the European pine shoot moth were concentrating on biological control of this insect which was becoming a potentially serious threat to western pine forests. Past research at the Station was directed at use of sex attractants for control during the adult stage. However, to get maximum effect of this method, reduction of the population during earlier life stages is needed.

In the spring of 1969, the Station tested the release of a native pupal parasite as a means of reducing the shoot moth population. Some 5,000 female parasite adults previously exposed to males were freed in an ornamental pine planting. At least 25 percent of the shoot moth pupae were killed by progeny of the parasite and an estimated 5 percent by the adult parasite. Abnormal high diurnal temperatures during the test period reduced the number of parasite progeny. Under normal temperature, increased mortality of shoot moth pupae would be expected.

Research on insect-killing virus of the Douglas-fir tussock moth showed that two viruses were involved and that these were infectious only to the Douglas-fir and closely related tussock moths. Extensive testing demonstrated the safety of these two viruses to man and wildlife, including beneficial insects.

Use of Forest Chemicals Present Opportunities and Problems

Use of chemicals in forest protection and management was becoming a public-sensitive practice, giving emphasis to the Station's work in this field centered at Corvallis. The key project headed by Tarrant was Behavior and Impact of Forest Chemicals. Other staff members were a soil microbiologist, a soil scientist, and a chemist. Related work, however, was being carried on in other forest, range and water management, and protection projects.

It was found in 1969 that fertilization of forest soils with nitrogen reduced survival of *Poria weirii* in buried wood samples under laboratory conditions. It was deduced that added nitrogen greatly increased activity of soil micro-organisms that adversely affect the pathogen. Also in 1969, the Station joined other public and private organizations to support a Regional Forest Nutrition Research project administered by the College of Natural Resources, University of Washington. The goal of this project was to develop guides for planning large-scale fertilizer applications to forest lands. Balanced series of fertilizer trials were established by cooperators of the project in western Oregon and Washington in 15- to 60-year-old stands of Douglas-fir and western hemlock. The tests were designed to predict growth response to a given application of nitrogen under specific stand conditions and environments.

The Station tested various herbicides in a continuing search for safe effective control of undesirable vegetation in intensive forest management programs. It was found in 1969 that foliage sprays of Amitrole-T, low-volatile esters of 2,4,5-T and mixtures of picloram with phenoxy herbicides, did not kill salal, a common understory plant in the Douglas-fir region, when applied in midsummer. It was also found that relatively rapid degradation of these four herbicides on the forest floor suggested that, properly used, there was little impact on the quality of the forest environment.

Another finding was that nitrogen fertilizer sharply increased wildlife injury to Douglas-fir seedlings when applied as urea prills (46 percent N).

3 As early as the middle of the 1950's, anti-pollution legislation at the Federal and State levels was enacted, which continued throughout the 1960's, culminating in the Act of 1970.

Recent studies demonstrated for the first time that different genotypes of Douglas-fir are not equally preferred by browsing animals. Apparently, essential oils of Douglas-fir affect rumen microbial digestion of deer, thus accounting for preference for some Douglas-fir seedlings and not others. If confirmed by later tests, this could lead to use of components of essential oils which inhibit digestion by deer as chemical protectants for preferred trees.

The vegetation of the Pacific Northwest is exceedingly diverse, ranging from dense coastal "rain" forests of conifers through woodland and savanna to the sagebrush and grass associations of eastern Oregon and Washington. Although the ecology and plant geography has been studied by plant scientists for many years, their writings had been scattered through scientific journals, books, theses, and unpublished file material. Jerry Franklin and Ted Dyrness of the Corvallis Laboratory staff reviewed this information and condensed it in a generalized account of the major vegetation types of the two States. It was published as USDA Forest Service Research Paper PNW-80, 216 pages, in 1969, under the title, "Vegetation of Oregon and Washington," a monumental accomplishment.

Forests of the Pacific Northwest have also been long known as a "paradise" for fungi above ground. Current exploration by another group of Corvallis scientists, the mycologists, found an astonishing array of subterranean-fruiting or hypogeous fungi and thus advancing the past limited knowledge of such fungi. Truffles is the best known of the various groups of hypogeous fungi, and this region was found to contain nearly half the world's known species. However, none were of the edible species so highly prized in Europe, much to the disappointment of Station gourmets.

A new needle disease causing extensive damage was found in southwestern Oregon ponderosa pine plantations established on sites difficult to regenerate with other species. The disease is caused by a previously undescribed fungus. It has not been found in natural stands.

Student Cooperation Advances Forest Recreation Research

Two graduate students at the University of Washington, working with the Station's Cooperative Recreation Research project, developed aids to the planning and protection of forest scenic resources. One student developed computed programs that drew perspective views of the landscape as it appeared from any selected point. With computer programs, location of roads, shapes of timber harvest areas, and other landscape modifications can be tested before commitments are made on the ground. Another student tested four methods of inventorying "visual impacts" on the landscape.

Study Given Conservation Groups

The conservation-preservation movement had become a major politico-economic development and was growing in political strength as indicated by successes in gaining numerous restraints on timber production. This group gathers its strength in a growing number of conservation organizations and outdoor clubs. A distinctly different philosophy is the conservation-utilization perspective supported by resource management professionals and commodity interests.

Members of the conservation groups can usually be classified as upper middle class. Often they are highly educated upper-income professionals with socially oriented extra-professional activities. To expand the body of knowledge concerning these apparently conflicting philosophies of conservation, the Station studied the characteristics of conservation groups in greater depth and the social aspects of outdoor recreation.

Study of an Oregon-based outdoor club showed that those members most actively interested in conservation as reflected by their membership in other outdoor clubs, specialize in the type of organization joined. This specialization may have reinforced extreme ideological perspectives and organizational commitment to a difficult cause.

Camping was long viewed as a way to escape the deteriorated environment and frustrating complexities of urban life to the beauties and restful quiet of nature. However, in response to growing demands from some people, the small, undeveloped campgrounds had been replaced by large, intensively developed campgrounds with most modem conveniences. It was found by the Station recreation staff that motives for camping are increasingly nontraditional and that many campers sought new social experience with many benefits. It was concluded that enhancing the social aspects of camping may be as important as is enhancing the environmental aspects of the more primitive type of camping.

Research in means of more intensive commodity use of the forest resource continued to gain ground as the Station's forest protection, management, and utilization continued to enlarge the information base of scientific facts.

Clean air acts in Oregon and Washington and establishment of Environmental Quality Departments drew public attention to forest fire smoke as an air pollutant which should be controlled, provoking study and discussion of slash burning practices. During 1969, over 4 million acres of forest and rangeland burned in interior Alaska, one of the worst fire seasons on record. Smoke from these fires extended as far south as Washington and Montana. The Station's fire control staff in Alaska measured rate of spread on several fires in cooperation with the Bureau of Land Management and the Office of Civil Defense. On one fire, rate of spread exceeded 1 mile per hour. Such information provides a basis for testing predictive fire behavior models for use of fire control organizations.

The effects of diammonium phosphate, a fire retardant, on the behavior and air pollution potential of slash fires were investigated in the field by a cooperative group including the Universities of California and Washington; the State of Oregon; the Monsanto Co., a chemical manufacturer; this Station and the Pacific Southwest Station and Region 6 of the Forest Service. Preliminary results of this large-scale study indicated this chemical did not significantly change fire behavior, did not increase fuel reduction, increased smoke output, and resulted in alarmingly high levels of carbon monoxide and hydrocarbons.

Progress continued to be made in finding ways to better establish a new forest after harvesting. For example, in 1969 a small seed orchard was established near Corvallis that will be a generation ahead of other Douglas-fir orchards. Material for the orchard was selected from the best 20 of 120 open-pollinated families field tested in the Douglas-fir Heredity Study, which was 57 years old in 1969. This seed orchard was set up to produce superior seed for medium-to-high elevations in the Cascade Range.

Economic Studies Produce Solid Facts

Considering the overall impact of environmental restraints greater attention was given to economic aspects of forest management practices. A study completed in 1969 showed that under most circumstances, it is more profitable to replace red alder stands with Douglas-fir than to manage for red alder in the Douglas-fir region of the Pacific Northwest. This conversion should take place immediately, except where sites are poor and when stumpage prices are low and costs are high. Under those conditions, red alder management may be justified.

It was found that average stumpage prices for timber sold on west-side National Forests had a long-increasing trend, which would probably continue throughout the 1970's. Regardless of the upward trend, prices fluctuated year to year, closely coinciding with changes in general economic activity and resulting variations in demand for wood products. Apparently year-to-year price changes were unrelated to variations in the quantity of National Forest timber sold and need for timber was the most important determinant of stumpage prices.

Two findings of the Forest Survey of the year point to restraints on timber supply. A reinventory of the timber resources of the Olympic Peninsula showed that the area of forest land available for growing commercial timber crops had decreased about 3 percent since 1953. Continued decreases are expected, particularly in the eastern portion of the Peninsula as a result of shifts in land use from anticipated population pressures.

Analysis of Forest Survey data in eastern Oregon showed that conditions limiting productive capacity were widespread. It became apparent in recent years that the procedure used for rating productivity overestimated the growth potential of natural stands.

Another economic study made on the Umpqua National Forest determined that accelerated roadbuilding in old-growth forests for prelogging and mortality salvage was a marginal investment from economic grounds. Additional benefits from access for improved fire control, recreation, and other land management needs would be needed to support advance roading.

Projections of forest industry employment were made to the year 2000. Total forest industry employment was expected to decline 28 percent during the 1965-2000 period to approximately 105,000 employees. Pulp and paper employment was expected to increase 17 percent, but this would be more than offset by a 39 percent decrease in the lumber industry owing to increased worker productivity and declining product consumption.

Dr. Hall Still Working

Dr. J. Alfred Hall, former director and a consultant to the Station, analyzed the prospects of the Pacific Northwest's capacity to double pulp and paper production by 1985 to meet national needs for these products. He predicted expanded use of the kraft pulping process and progress in improving water quality and reducing air pollution through recovery of sulfur dioxide. He counted on aggressive utilization of logging residue, thinnings, and current underused species to meet the 1985 wood needs of the industry.

Another study concluded that agricultural use of the million of tons of tree bark produced annually by the timber manufacturing industries would alleviate disposal problems and air pollution arising from wigwam burning.

Environmental Considerations Feature the 1970's

As the decade of the 70's opened, it was clearly evident that the Nation was entering a new era of natural resource use and management; an era of conflicting public issues which would heighten the complexity of decision-making by public and private forest land managers. Articulation of public concern about environmental aspects of natural resources was becoming insistent and compelling. At the same time, economic considerations were becoming acute; housing shortages, unemployment, and a growing importance of timber products in foreign trade were prominent among these.

This situation exposed the need for more exact knowledge to appraise the alternatives that should precede critical decisions in dealing with our forest and related land uses.

Much of the Station's research past and present provided many of the needed answers. However, the dynamics of the present conditions demanded greater progress on current programs and new approaches.

In 1970, the Station formulated and initiated a new multiproject research program, Forest Residues Reduction Systems, designed to develop better methods of wood residue utilization and disposal through directing knowledge of many disciplines on a major problem composed of a number of interrelated parts. This undertaking was staffed by the transfer of John M. Pierovich from Region 3 of the Forest Service as project leader, headquartered at Seattle, and transfer of John Dell, research forester, and Franklin Ward, research technician, from the Pacific Southwest Station. These two men were located at Portland where they had been working for several years on a cooperative slash disposal project with the Region 6 Fire Control staff.

Each year a number of key personnel changes occur and 1970 had important ones. Richard M. Hurd, assistant director for the Alaska units, retired in July. Rather than replace him, Alaska projects were supervised by the appropriate assistant director headquartered at Portland.

Dale Potter was added to the staff of the Wildland Recreation Research staff in Seattle as a research forester to study the preferences of big-game hunters in the Pacific Northwest. Dr. John J. Stelzer transferred from the Rocky Mountain Station in Albuquerque to join the Diseases of Western Forest Insects work unit at Corvallis as a research entomologist.

Dr. Roger Fight left the University of Wisconsin faculty to join the Production Economics Research staff in Portland as a research forester, replacing Dan Chappelle who joined the faculty of Michigan State University. Dave Darr, research forester, joined the Marketing Economics Research staff. Dave came from the University of Minnesota, making the Station one up on the academics for the year. Dan Oswald, formerly headquartered at Berkeley handling the Forest Survey for California, moved his physical headquarters to Portland during 1970.

Dr. Donald Schmiege, project leader of Forest Insects—Coastal Alaska Research work unit, transferred to the Pacific Southwest Station at Berkeley. By invitation, Dr. Jerry Franklin spent 8 months of the year in Japan to study and establish a full exchange program on subalpine forest problems common to Japan and the Pacific Northwest, a testimony to international recognition of his scientific achievements.

In midyear, construction was commenced on the laboratory services building adjacent to the Corvallis Forestry Sciences Laboratory. Completion of this work in 1971 was expected to make this total facility more efficient and complete.

Research results of the Station are disseminated not only nationally but worldwide. In 1970, a total of 205 publications were issued; 52 5-minute radio programs were released; and many news releases, addresses, and work conferences added to the program of putting research results to work as a public service.

Interest in Wood Residues Increases

The 1969 pilot study to determine quantity and nature of logging residues developing from clearcutting on National Forests in western Washington was expanded in 1970 to cover all of Washington, Oregon, and California.

Sawdust, another wood residue formerly a disposal problem for the sawmill industry, was being used for a number of purposes. One of these was horticultural mulch. This market was accounting for an increasing quantity of sawdust. Most sawdust is highly beneficial to plant growth, but some darkened sawdust was found to be damaging to nursery stock. Dark brown or black sawdust was discovered to be injurious to plants because of extreme acidity which developed when it is stored in moist, compacted, large piles.

During the 1930's and earlier, sawdust was used commonly for residential heating in urban areas of the Pacific Northwest. Slabwood, another waste product of the sawmill industry, was also used in large quantities. These materials were also used for commercial heating to some extent and for generation of electrical power. The growth of hydroelectric generation in this region furnished cheap power, and greater use of electricity for heating and industrial purposes resulted. However, by the post-war period, natural gas and petroleum largely replaced wood products in residential and commercial building heating. By 1970, interest was beginning to develop in other sources of energy as signs of shortages of petroleum, natural gas, and new sites for hydroelectric generation began to appear. Environmental factors stopped development of new hydroelectric generation several places in the region. Nuclear energy, which was thought to be the solution to the energy problem, was encountering difficulties chiefly stemming from environmental and safety factors. Greater interest was given to coal and wood as a source of energy to help meet growing demands for domestic and industrial use, giving emphasis to the study of logging residues.

Progress Made in Protecting Forest Environment

Disposal of logging residues by burning also was experiencing environmental objections. The Station's analysis of atmospheric ventilation indicated the best combinations for various parts of the Pacific Northwest to minimize degradation of air quality.

Other findings of the Station during the year also contributed to progress in protection of the forest environment. A Station watershed scientist developed an automatic pumping sampler, which accurately sampled water in proportion to streamflow, making available a valuable tool for measuring the influence of forest practices on stream environment and water quality and quantity.

Studies on the Andrews Experimental Forest of the chemical quality of a stream following logging and slash burning showed that ammonia nitrogen and manganese exceeded Federal water quality standards during a 12-day period following the burning. After that, these chemicals rapidly dropped to below the limits of detection. Increases in quantities of other chemicals measured did not exceed quality standards at any time. Nitrogen measured in rainfall was nearly equal to loss of dissolved nitrogen. Other nitrogen attached to sediment may be lost following burning, suggesting the importance of minimizing sediment losses.

Studies on the Prince of Wales Island, Alaska, showed that most debris avalanches and flows develop on slopes exceeding a 34 gradient. An isosine map (slope angles), delineating areas of slope instability, provides information for special preventative planning in timber sale layouts, harvesting methods, and road systems.

A method was devised for measuring the effect of shade on stream temperatures under the cool, moist weather conditions of southeast Alaska. That technique was used to develop procedures for predicting effects on stream habitats by removal of streamside vegetation and various patterns of clearcutting.

Work continued on studies of various uses of forest chemical and development of biological control alternatives to forest chemicals used as insecticides, fungicides, and herbicides.

It was found that natural controls on sawfly females by tree host, disease, and parasites apparently account for this insect's inability to reach epidemic proportions in western hemlock. This was expected to eliminate need for artificial controls of the hemlock sawfly in the coastal forests of Alaska.

Three synthetic compounds of the sex attractant of the female European pine shoot moth were found to effectively block the males' ability to find the females. This was a promising lead in finding a selective control agent for this potentially dangerous insect.

Zectran, an insecticide under study as an alternative to DDT, was found to offer no hazards to soil microbes when applied in low volumes. It was known that levels in plant foliage decreased rapidly in contrast to DDT, making this forest chemical safe for use by aerial application against forest tree defoliators such as the tussock moth.

Progress was also being made in other aspects of aerial application of insecticides at the Station. Better spray formulations, equipment, and methods for determining spray dispersal, target coverage, and draft were developed.

Prospects indicated that growing public concern about the use of herbicides could result in prohibitions in the use of 2,4-D and 2,4,5-T. These chemicals had become virtually indispensable in Pacific Northwest silviculture. Earlier tests of 2,4-DB and Nmmate X and other herbicides showed that the two named were effective on two brush species but apparently not on many other undesirable species. It was concluded much more work needed to be done to find replacements for 2,4-D and 2,4,5-T.

The forest floor is the major receptor of aerially applied herbicides. Any quantity not absorbed is not available immediately for transport to other parts of the environment or degradation. Station studies in 1970 showed the absorptive capacity of forest floor material is greatest for 2,4,5-T, less for 2,4-D, and lower for picloram.

Poria weirii, a very destructive root-rotting fungus of conifers regarded as a "disease of the site" rather than simply a killer of individual trees, responded to biological control. It was concluded that a possible therapy for infected Douglas-fir sites was encouragement of *Poria*-inhibiting red alder on the site. Another forward step in control of *Poria* was the discovery by Station and National Forest personnel that *Poria* infection centers show a distinct pattern on aerial photos of true fir-mountain hemlock stands in the Oregon Cascades.

Studies showed that mycorrhizal fungi benefit trees by detoxifying soil as well as protecting roots from disease and improving tree nutrition. This inspires the axiom, "good mycorrhiza management is essential to good forest soil management."

The 5,040-acre Entiat experimental watershed was burned over on August 24, 1970. Started by lightning, this wildfire covered a total of 45,000 acres and threatened total loss of a 11-year research program on the experimental area. Fortunately, Station scientists, by a prompt and thoroughly planned shift in research emphasis, converted an apparent disaster into a unique scientific opportunity. The plan adopted included study of effects of fire on ecology of the area, evaluation of the Forest Service's emergency revegetation program instituted after large conflagrations, and appraisal of timber salvage methods and new types of logging equipment. Obviously, study of erosion control methods were a prominent feature of the overall plan.

The Recreation Research unit found that wilderness users were more willing to comply with suggested behavior controls than wilderness managers had estimated.

A cooperative study of National Park Service, Forest Service, and State of Washington visitor centers identified factors that help explain why visitors find some exhibits more interesting than others.

Preservation of pleasing forest landscapes requires knowledge of the plant successional changes constantly occurring and their potential impact on important landscape features. The Station documented an important ecological change in the subalpine meadows of the Cascades. This was a massive invasion of these meadows by tree seedlings, chiefly alpine fir *(A. lasiocarpa)* and mountain hemlock *(T. mertensiana).* History of these changes suggests that climatic change was the most probable cause. Information gathered by the Station supported the conclusion that if the meadows were to be preserved, tree encroachment must be controlled by cutting. This presented another dilemma to some forest preservation advocates. Evidently varying degrees of management are required in wildland recreation use which will undoubtedly create controversies. Resolution of such conflicts emphasized the need for a continuing strong program of forest recreation research, particularly in the Pacific Northwest.

Research Answers Regeneration Problems

Research in forest genetics and physiology produced several interesting results during 1970. A tentative answer was found to the question, "What portion of a tree's seed crop develops from its own pollen?" Trees tested so far showed an average percent of self seeding in wind-pollinated families was about 7.5 percent. This finding implies that a large proportion of the pollen a cone receives comes from the bearing trees.

Other tests showed that the potential for genetic improvement of seedling height growth in Douglas-fir appeared to be promising. This result should help solve regeneration problems. An inheritance study underway in Douglas-fir indicated that graft compatibility was a strongly inherited trait.

Comparative studies of the effectiveness of various formulations of foliar sprays versus dry urea granules applied to seedlings and established stands of Douglas-fir gave encouraging early findings. Spray caused a greater improvement in color than urea granules. Owing to the close correlation between needle color and growth of this species, significant increases in volume were anticipated in subsequent growing seasons. More studies were planned to determine long-term effectiveness of the two treatments.

Regeneration studies continued to produce additional data; in spite of this progress, unresolved problems remained to hamper intensive management of the diminishing area of forest land dedicated primarily to timber production.

Douglas-fir plantations in southwestern Oregon have repeatedly failed. Studies made of influence of shade on seedling survival reached the conclusion that although “dead shade” produced the best survival, it was expensive and that planting under brush might be the best alternative.

In the more humid coastal areas of Oregon and Washington, a different regeneration problem existed. Studies made over the past 15 years showed significant increases in salmonberry crown cover following thinning of the conifer overstory. Repeated thinnings under intensive management led to increased salmonberry cover in many coastal forests, and control measures were needed to the degree it competed with establishment and growth of the seedlings.

Cold snaps occasionally occur during the usual mild September weather in the Pacific Northwest, damaging plants still actively growing, including conifer nursery stock. Recent studies indicated that Douglas-fir damaged by frost should not be culled heavily or seedlings with good growth potential would be lost.

It was also learned that damage by blue grouse in Douglas-fir plantations appeared to be more common than believed, particularly when seedlings were small. Douglas-fir needles and buds were found to be a principal winter food for these birds.

Hydrogen peroxide had been used to speed germination of conifer seeds in laboratory tests, and it was also considered for use on seed sown in nurseries or the field to shorten time seeds were exposed to adverse factors. A yearlong comparison of laboratory grown conifer seedlings, germinated from stratified and peroxide-treated seed, indicated that the latter could not be recommended for use in operational sowings.

Recent studies at Olympia showed that growth of Douglas-fir seedlings in the nursery and outplantings was essentially the same under fertilization with nitrate and urea and both were superior to ammonium. Susceptibility to browsing by captive black-tailed deer did vary among the three treatments.

Another comparative study in southwestern Oregon showed that terbacil, a wettable powder applied in a water carrier during early spring, released Douglas-fir seedlings from a broad spectrum of grasses and forbs without damage to the seedlings.

As a first step in providing reliable growth information for management of upper-slope forests in the Cascades, site index curves were developed for noble fir *(A. procera)* based on stem analysis data from a number of locations.

Gathering evidence had suggested that there were many areas of western forest lands incapable of supporting the amount of stocking indicated by the normal yield tables owing to restrictive site factors. A preliminary study on private lands in northern California indicated that roughly half of the forest land was in this category. A procedure was developed by this Station’s personnel for predicting stocking capacity of a given area based upon site index, elevation, and presence of certain indicator plants.

Economic and Engineering Studies Produce Important Data

A study by the Station involving the BLM Tillamook Resource Area demonstrated that operations research technique combined with economic analysis provided valuable information otherwise unavailable to forest managers planning intensive management of young-growth Douglas-fir.

Another economic study involving young-growth timber showed that accelerated roadbuilding, although slightly increasing allowable cut of public lands, was uneconomic owing to increased costs. This confirmed an earlier study in old-growth forests which reached the same conclusion.

Studies of log consumption and plant characteristics of the timber industry in 1968 in the three Pacific Coast States, done in cooperation with the State Foresters, were completed. Resulting publications provided valuable information for analysis of the relationship of various forest product industries to the timber resource, significance of timber ownership to particular industries, use of plant residues, and similar questions of wide interest.

Analysis of log prices in western Washington and northwestern Oregon during the past decade showed a substantial increase, mostly occurring in 1968 and 1969. The rate of increase exceeded the rise in the wholesale lumber price index considerably, and greatly exceeded rise of the all commodity wholesale price index. The study also showed a widening gap between domestic and export log prices.

Softwood log exports from Oregon and Washington set a new annual high in 1970, totaling 2.2 billion board feet. Shipments from Alaska also set a new record of 51.5 million board feet. Northern California declined slightly in 1970 from 1969 figures to 192 million board feet.

Release of this information stimulated political controversies between opponents and advocates of log exports.

A new report on timber resources of the Puget Sound area, comprising eight counties, showed 3.3 million acres of commercial forest in 1967, a reduction of 260,000 acres since 1953, and a sawtimber volume of about 75 billion board feet, a reduction of about 6.5 billion board feet during the same period. However, for the area as a whole, average annual cut was only about 4 percent more than growth. This gap was expected to close as more of the slow-growing old stands were converted to faster growing young stands.

A similar timber resource inventory and analysis for the eight-county area east of the Cascade summit in central Washington reported a drop of about 10 percent in sawtimber volume and 5 percent in commercial forest land during the past decade. Increasing pressure of recreational use in this area was expected to result in further reduction of timber resource for manufacture of forest products.

A report by Dan Oswald of the Forest Survey staff gave projections of the forest industry situation in California to the year 2020. It indicated that although timber harvest would decline nearly 20 percent, total employment would increase about 61 percent. This increase in jobs was expected to occur primarily in the population centers through rise in secondary manufacturing activities.

The Station's Forest Engineering project in Seattle in cooperation with the University of Washington was selected as one of the locations in a national program for advanced training in logging systems engineering. Since 1966, a total of 11 selected engineers had been enrolled in the 2-year program; seven returned to the field to apply this training.

During 1970, research studies in Oregon and Washington provided timber appraisers and industry management with up-to-date lumber and veneer recovery data for Douglas-fir, white fir, western hemlock, and Sitka spruce.

The Seattle wood construction group reported on the sound insulating properties of five different wood floor systems evaluated in nine apartment buildings and one motel.

A cooperative study with Oregon State University found that an extra margin of environmental protection plus an increase in beef production appeared feasible through early weaning of range beef calves. This conclusion was based upon preliminary results from a weight gain comparison of March calves weaned the first week in September versus those weaned the first week in November. Early removal of calves from mountain summer range to a weaning ration decreased animal nutrition demands on the rangelands.

1971—A Change in Command—BrieglebSucceeded by Buckman

Each year brings a number of personnel changes to the Station; however, some years the number and significance of these moves is of extra significance. Nineteen seventy-one was such a year. Personnel changes are inevitable owing to retirement, transfers of personnel to positions at other locations offering advancement and more varied experience, intra-Station promotions, and illness, and death. Fortunately, no vacancies from the last reason occurred during 1971. Retirement resulted in a major change; on May 31, Director Briegleb retired after more than 40 years in Forest Service research and heading the Pacific Northwest Station for the past 8 years. Phil Briegleb commenced his career in forest research at this Station July 1929. In the following years, he served as Director of three Federal Forest Experiment Stations and distinguished himself for personal research in forest management and forest research administration, achieving international as well as national recognition as a forest scientist. Based upon his attainments, he was elected president of the Society of American Foresters, serving in his capacity during 1964 and 1965. Phil also spent 6 months in 1944 on a forestry aid mission and attended a number of international forestry meetings and conferences. He also served on the forest faculty of the University of California as a visiting lecturer for an academic term.

Dr. Robert E. Buckman became the sixth Director of the Pacific Northwest Forest and Range Experiment Station effective June 1971. His career in forest research included 10 years in silvicultural research in northern conifers at Grand Rapids, Michigan, and 6 years in the Washington, D.C., Office in several assignments, the last of which was assistant to the deputy chief for Research.

The changing nature of forest research arising from the need to fully understand the interrelationships of multiple uses—water, recreation, timber, wildlife, and livestock—was reflected in the evaluation of a dynamic organization with a continuing effort to find the way to attack these problems most effectively. This resulted in staff changes, bringing new people to the staff and shifting assignments or location of current staff members.

Other Organization Changes

The multidisciplinary Forest Residues Program initiated in 1970 was an example of this approach. A more enlarged development of this concept was the consolidation of the four projects headquartered at Fairbanks, Alaska, into a single interdisciplinary team under the leadership of Dr. Charles Cushwa. Formerly, these projects were under the overall direction of three assistant directors. Following the consolidation, the new project, named “Environmental Systems—Interior Alaska,” was under the direction of assistant director Kenneth Wright. Dr. Cushwa, principal wildlife biologist and project leader, came to the Station from the Pennsylvania Cooperative Wildlife Research unit at Pennsylvania State University, Mount Alta.

Another new organization which embodied this principle was the Coniferous Biome study for the western States of the International Biological Program. This was organized as a major cooperative effort between Oregon State University, University of Washington, and the Forest Service to understand better how western conifer forests function. The objective was to predict the consequence of alternative management practices on productivity of these forests of high national importance. Dr. Jerry Franklin was named deputy director of this study.

Project FALCON (Forestry, Advanced Logging, and Conservation), another major research and development program, was assigned jointly to Region 6, and the Station. It consisted of a search for new and improved timber harvesting methods to reduce environmental damage. This objective ties in closely to other projects already underway at the Station. Detailed planning started in 1970 under the direction of assistant director Don Flora and Edward Clarke, the latter returned to the Station after 10 years in the Washington Office where he headed a national research program on timber and wood quality.

Assistant director Robert W. Harris was appointed Director of the Intermountain Forest and Range Experiment Station at Ogden, Utah, July 8, 1971. Bob succeeded Joe Pechanec, another former PNW member, who retired. Robert F. Tarrant was promoted to assistant director, Forest Environment Research—People and Forest Resources, replacing Bob Harris. Tarrant, a versatile trouble shooter, had been commuting back and forth between Corvallis and Portland, filling wherever needed. His new headquarters were Portland; however, his travels would be farther afield, since he directed two Alaska projects.

A change in another key position of the Station staff developed from the transfer of David Tackle in September 1971 to the Washington Office as chief for Conifer Ecology and Management in the Division of Timber Management Research. Dr. Robert M. Romancier replaced Tackle at this Station, coming from the Washington Office, Division of Timber Management Research.

The Washington Office drew unusually heavily upon the Pacific Northwest Station for talent in 1971. Three other top men were called back to Washington. H. W. Berndt, leader of the Water Yield and Erosion Project at Wenatchee, Washington, became assistant director, Division of Flood Prevention and River Basin Programs, State and Private Forestry; Dr. Keith R. Shea, project leader, Forest Diseases of the Pacific Northwest at Corvallis, became branch chief for Forest Disease Research; and Dr. James L. Murphy, project leader, Cooperative Forest Fire Science at the University of Washington, became staff assistant to the deputy chief for Research.

All the vacated positions were not filled immediately. Dr. William Lopushinsky led as project leader at Wenatchee and the position at Corvallis, formerly occupied by Dr. Shea, was left vacant during 1971. Dr. Logan A. Norris was named project leader of Behavior of Forest Chemicals at Corvallis, replacing Tarrant, and Dr. Robert E. Martin succeeded Murphy as leader of the cooperative fire project in Seattle.

Dr. Con Schallau transferred to the Intermountain Station in Ogden, Utah, as assistant director. He was replaced as project leader of the Production Economics Research unit by Dr. Dennis Schweitzer.

Several more scientists were added to this Station's staff, giving additional strength to important projects. Dr. Douglas N. Swanston, a geologist and expert on soil mass movement problems, joined the Soil Stabilization project at Corvallis. J. D. Helvey, formerly at the Coweeta Hydrology Laboratory in North Carolina, joined the Wenatchee Laboratory, increasing staff expertise in hydrology.

Thomas Farrenkopf moved from the Intermountain Station to the Forest Survey Techniques Research unit, increasing the staff to three. Michael J. Gonsior, research engineer, moved from the Intermountain Station to Bozeman, Montana, to assist in the FALCON program at Portland.

John S. Hard was promoted to project leader for Research on Forest Insects of Coastal Alaska at Juneau.

The Station lost Charles Newlon, who transferred to Region 1 as branch chief for Information Services at Missoula, Montana. “Chuck” left behind a smoothly working and effective information program at the Portland Station.

Women members of the Station have had an important place in its operations and productivity. A prominent example of the Station’s personnel policy of giving responsibilities to women and offering career opportunities to them is Mrs. Barbara Hague. in 1971 Lorne Calvert, Operation branch chief and a top aid to assistant director “Chuck” Petersen, transferred to the same position at the North Central Forest and Range Experiment Station in St. Paul, Minn. Barbara, budget and accounting officer since 1968, was promoted to the vacated position and early was classified as Administrative Officer, GS-13. She joined the Station as a GS-2 multilith operator, and in this comparatively short period had competently filled successively more responsible jobs.

Progress Made in Communicating

Translation of new knowledge gained from research into forestry practice is a perennial problem. As the storehouse of information enlarges, the task of technology transfer, as this process is often called, becomes more difficult and important. A multiple-point program was adopted to meet specific needs of users. Preparation of summary publications drawing existing information together which would meet needs of some users and also provide a point of departure for new research was initiated. Effective use of the popular media is another means for dissemination of scientific forestry facts. Finally, the Station sought a better way to tailor specific scientific findings to needs of public and private forest land managers. Appraisal of several means of communicating was commenced during the year.

Greater emphasis on nontimber uses of the forest resource not only widened the scope and depth of research programs but also greatly enlarged the number and range of interests of the Station’s audience.

One forest recreation study compared portable cassette tape players with signs for effectiveness in interpreting attractions of a National Forest nature trail to visitors. The tape players proved more effective in stimulating visitors’ interest and increased visitors’ retention of specific information. Another study of values, behavior, and modern camping culture found that the highly structured social makeup of modern campgrounds apparently was consistent with the recent converts’ ideas of what camping is all about. The incentive approach to litter control, when tested for operational feasibility and compared to regular cleanup procedures, indicated that the incentive approach reduced litter levels greatly below the normal procedures and at a much lower cost.

Natural Areas

Over the years since the Station first launched the Research Natural Area Program in the Pacific Northwest, other agencies have been brought into a cooperative Federal program. This program now (1971) also involves the Atomic Energy Commission, Bureau of Land Management, Bureau of Sport Fisheries and Wildlife, and National Park Service.

Excellent progress was made in 1971 in identifying kinds of ecosystems still in need of representation within natural areas and locating appropriate examples of these ecosystems. Also in 1971, the Station, in cooperation with the other local agencies, was host to members of the Federal Interagency Committee on Research Natural Areas and of the Conservation of Ecosystems Section in the International Biological Program. A prime purpose of their visit to this region was to examine the exemplary program in progress here.

Station scientists also led in the preparation of a draft of “Federal Research Natural Areas in Oregon and Washington: A Guide for Scientists and Educators.” It was planned for publication in 1972 as a contribution to the U.S. International Biological Program.

Forest Protection Progresses

Continued progress was made during 1971 in development of biological controls for forest insects and diseases and in reducing dependence upon environmentally questionable forest chemicals.

The Douglas-fir tussock moth continued to be a major research target. Station scientists discovered, while working on a method for utilizing a natural virus, that three different viruses were involved. This was an important discovery since each different virus strain must be tested and meet Food and Drug Administration stringent requirements as to safety and identification before operational use.

Silvicultural controls of insects also are an important tool of forest managers. The lodgepole needle miner, a serious defoliator of that tree species in central Oregon, attains high populations only where there are many susceptible trees. It was found that certain parts and forms of trees have foliage resistant to attack by this defoliator. Cultural practices that favor the resistant type of trees were believed to offer a means of preventing serious outbreaks.

The search for biological control methods of root rots included locating hyper parasites. Station scientists discovered a fungus that overruns and kills root rotting fungi in laboratory studies, thus presenting an intriguing possibility for *Poria* control.

Poria weirii had long been recognized as a lethal root rot of conifer poles and sawtimber throughout the Douglas-fir region. Now it has been identified as the pathogen killing reproduction in a number of west-side Douglas-fir plantations.

The highly infectious Port-Orford-cedar root rot, *Phytophthera lateralis,* and which threatens extinction of this valuable and rare tree species within its natural range, has the potential of spreading to uninfected areas. No evidence of inherited resistance in the host tree species has been found and chances for chemical control are low. Forest pathologists of Oregon State University Region 6, and the Station have developed a set of recommendations of physical measures for delaying, if. not totally preventing, spread of this pathogen to uninfected areas. Port-Orford cedar is not only a valuable tree species for timber products, but also is widely used throughout the Pacific Northwest for horticultural planting.

Ponderosa pine seedlings infected with dwarfmistletoe were determined to be a poor risk and should be eliminated from managed stands.

Studies of behavior of picloram and 2,4-D in soils on sprayed rights-of-way found that these herbicides did not leach extensively and were apparently rather quickly degraded by soil microorganisms.

Zectran, an ecologically acceptable insecticide, was registered for use in controlling three serious defoliators, western spruce budworm, spruce budworm and jack-pine budworm. Qualitative and quantitative spray deposit assessment methods for the registered Zectran formulation were developed in 1971 and successfully field tested in Idaho in cooperation with Region 1 of the Forest Service.

A vital factor in spraying herbicides for release of young conifers from brush competition in this region is timing of the application owing to seasonal susceptibility to phenoxy herbicides. This is especially true of ponderosa pine which has high susceptibility. Studies in southwestern Oregon showed that full resistance to 2,4-D and 2,4,5-T was not reached until August, and then trees of this species were resistant until late winter.

Range and Wildlife Management Studies

Important information was gained during 1971 on the seasonal trend of food reserves in elk sedge, a high-value livestock forage plant and key understory herb in Northwest ponderosa pine ecosystems.

Another widespread and highly palatable forage plant on Northwest ranges is bitterbrush. It was found that heavy grazing of this shrub increases yield per plant but reduces yield per acre because of shortening of its life span. It was concluded that quality of grazing is probably as important as quantity owing to the relationship of protein content to age.

Studies initiated on the Entiat experimental watershed were producing interesting 1st-year results. Permanent belt transects established to measure progress of natural and artificial revegetation showed that by August 1971 about 9 percent of the ground was revegetated. Most of this cover consisted of native species.

Another study on the Entiat area showed that forest fires dramatically change streamflow and soil moisture storage.

Analysis of the results of several years' study of browsing of Douglas-fir by black-tail deer gave information valuable to forest and game managers. This "critter" was found to be responsible for reforestation delays in many plantations in this region. Detailed findings of the study provide the means to predict levels of tree browsing from given intensities of deer activity and to establish compatible goals for tree growth and deer production.

Other studies enabled the Station to predict the susceptibility of Douglas-fir seedlings to damage by the snowshoe hare on the basis of tree parentage. This opened the way for use of captive animals to predict the relative resistance of seedlings planted in the field and selection of tree families with the strongest inherited resistance.

Genetic studies determined that date of bud set could be used to screen races of coastal Douglas-fir for fall frost resistance but adding a factor related to latitude noticeably improved screening precision.

A Christmas tree study begun in 1964 attained a major landmark in Northwest forest genetics in 1971 when the Station released 13 pounds of genetically superior Christmas tree seed. This elite seed originated from the best parents of study trees selected equally in Oregon and Washington. Equitable distribution of the superior seed was worked out by the Region-6 Division of State and Private Forestry for the benefit of the Pacific Northwest Christmas tree industry.

Abrupt boundaries between ponderosa pine and lodgepole pine stands commonly occur in the pumice soil region of central Oregon with only a slight change in topography. Lodgepole pine was usually found in the pine stands in the lower flats with ponderosa pine dominating the neighboring higher site. Study showed that this distribution of lodgepole was probably related to occurrence of low minimum temperature on the flats during germination period. Tests of 6-to-8-day-old seedlings of the two species showed that lodgepole had the greater tolerance to low temperatures.

Study showed that conifer nursery stock were best protected from desiccation during storage and planting by coating them with a moisture-retaining material such as clay slurry, sodium alginate, or xanthan gum. Moist sphagnum moss or other packing material which had been commonly used didn't give uniform protection throughout a bundle of trees.

Tests showed the development of systems for producing containerized seedlings uniform in size and quality could increase success and flexibility of forest tree plantings.

Forest Mensuration Studies Advance

The Forest Mensuration staff developed a new approach to making stand table projections for timber supplies. This involved establishing a firm limit on buildup of basal area per acre through adjustment of initial radial growth and mortality rates during the course of the projection. This produced more reasonable stand densities than the old method used for long-term projections.

Another mensuration study developed five equations for estimating Dunning's ponderosa pine site class by noting the presence or absence of certain plants and other indicators. Each equation was developed for a specific area in California and was designed for use on cutover areas, burns, and other areas where site trees were absent.

Accurate methods have long been needed for estimating loss of timber volume in white fir *(A. concolor*) stands in southwest Oregon. Methods were developed for relating decay defect to external indicators, including conks of heart rot fungi, basal injuries, frost wounds, forks, and dead or broken tops. The most reliable of these indicators was the Indian paint fungus.

Up in the Air

Efforts to introduce aerial logging methods produced significant results in 1971. The first balloon logging system for use in Alaska was purchased by a local company, and plans were made to begin operations on the Tongass National Forest in southeast Alaska early in 1972. Another new balloon logging operation was begun on the Boise National Forest in southern Idaho. A new mobile running skyline yarder operation started in 1971 on the east side of the Mount Hood National Forest, using a yarder developed to Station-prepared specifications. It was designed to economically harvest partial cuts in areas too steep or fragile for tractors.

Wood Residue Facts Collected

The Station documented the volume and characteristics of logging residue developed in Oregon, Washington, and California in 1969. A total 900 billion cubic feet of residue wood in pieces at least 4 inches in diameter; 4 feet long, and physically suitable for pulp chips was found in the three States; 465 million cubic feet, or more than half the total, was found in the Douglas-fir subregion. That figure was equivalent to the 1969 total raw material consumption by the pulp, paper, and board industry in the region.

The highest volume of logging residues was found on National Forest land the Douglas-fir subregion, averaging about 3,150 cubic feet per acre. This compared to 2,100 cubic-feet private lands. However, much of the difference was due to preponderance of old-growth stands on National Forests where defect and breakage are heavy.

About 2.1 billion cubic feet of wood residues were developed in Oregon, Washington, and California primary timber manufacturing plants during 1970. In that year, 87 percent of the coarse residues, 64 percent of the sawdust, 82 percent of the shavings, and 53 percent of the bark produced by these plants were used for fiber products, fuel, or miscellaneous uses. Long-term trends show an increase in percent of the residue total used and a shift toward fiber product use and away from fuel.

Analysis of current data indicates that the total conversion process from logging to primary product to use of plant residues results in use of as much as 86 percent of the total cubic-foot content of the tree. Logging efficiency was probably at an alltime high at that time with between 85,and 95 percent of the standing tree cubic volume used. In contrast, sawmills and plywood plants had not made significant gains in long processing recently with only 44 to 50 percent of the log converted to the primary product. Technology gains have been offset by use of smaller and poorer quality logs.

Reduction of logging residues is an important objective of forest managers so that cutting areas will have a cleaner appearance, fire hazard will be reduced, and the job of reforestation and subsequent management facilitated. The market research staff started study to identify economic incentives for better logging utilization.

Station economists, in cooperation with the Bureau of Land Management, produced a forest projection model called SIMAC(Simulated Intensively Managed Allowable Cut), specifically designed to calculate allowable cuts for intensively managed forests. The model is adapted to estimating future timber supplies from both public and private timberlands in the Douglas-fir region.

The Alaska Challenge

The two centers for research in Alaska at Juneau and Fairbanks were now organized and geared to tackle the tremendous challenge in the relatively undeveloped but potentially rich forest resources of Alaska coastal Alaska and interior Alaska present differing and complex problems for the forest researcher.

A symposium to discuss the wildfire problem in interior Alaska was held at the University of Alaska at Fairbanks. During a 2-day session more than 100 persons representing 30 organizations discussed and gave opinions on wildfires, their control and role in Alaska environment. This was a first effort to bring together in open forum natural resource managers, fire control specialists, scientists, and citizens.

Specific studies underway in Alaska gradually added to the reservoir of information. Work with white spruce (*Picea glauca*) in the interior revealed hat seed of this species mature around the first week in August. The best time for collection was determined to be no earlier than 2 weeks prior to natural seed dispersal, which varies from mid-August to early September.

Winter cold is a major factor in insect population fluctuations, particularly in Alaska where the spruce beetle *(Dendroctonus rufipennis)* does not survive freezing. However, this insect avoids freezing by supercooling. Laboratory studies at Fairbanks showed that this insect could supercool anytime during the year and that the supercooling point is depressed to near -38.8°C during midwinter. With protection of snow cover much of the population can survive the colder air temperatures which commonly occur in this area. An understanding of how and when these phenomena occur will be helpful in predicting trends of this insects population.

Analysis of two recent outbreaks the black-headed budworm in southeast Alaska showed a highly significant relationship between severity of outbreaks and temperature during active periods of the insect's life cycle. Findings of this study support the hypothesis that animal populations are controlled largely by weather near the periphery of their natural range. Southeast Alaska is close to the northern extremity of this insect's geographic distribution.

Value of Alaska-cedar and western redcedar increased substantially over the preceding few years and in 1971 had a higher average log value than any other Alaskan species. The market for Alaska-cedar in round log form was almost entirely foreign. This emphasized the need for more precise volume measurement. To meet this need, new volume tables were developed for the two species in 1971.

International attention was accorded forestry in Alaska when Emperor Hirohito made a stopover in Anchorage en route home to Japan from a European tour. Dr. Leslie Viereck of the Station's Northern Institute of Forestry and John Raynor, Chugach National Forest, organized and setup a display of plants from both countries. Herbarium specimens and taxonomic reference were reviewed by the Emperor and Empress as Dr. Viereck explained the relationship of Alaska flora and Japanese mountain flora.