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Yale Forest in Tolland and Windham

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Headquarters of the Yale Forest in Tolland and Union Counties, Conn. The Fairbanks house, said to have been built about 1732, remodeled for occupancy in 1931, is located three-quarters of a mile south of Union, Conn., and is the control center of forest activities.

YALE UNIVERSITY · SCHOOL OF FORESTRY

Bulletin No. 55

THE YALE FOREST
IN
TOLLAND AND WINDHAM COUNTIES,
CONNECTICUT

BY

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ILLUSTRATIONS

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THE YALE FOREST IN TOLLAND AND WINDHAM COUNTIES, CONNECTICUT

INTRODUCTION

THE Yale Forest in Tolland and Windham Counties of northeastern Connecticut, commonly known as the "Union Forest," is a tract of 7,858 acres granted to the Yale School of Forestry in the years from 1930 to 1934 through the generous gift of Mr. George Hewitt Myers, a member of its first graduating class. This tract is one of three areas now owned by the School and one of six or more areas on which extensive instructional, demonstrational, and investigational field work is being conducted. The second school-owned tract is the Yale Forest at Keene, N.H., covering about 1,400 acres, chiefly in the white pine type, the original nucleus of which was also a gift of Mr. Myers. The third is the Bowen Forest of 460 acres, located in the Green Mountains near Mt. Holly, Vermont, characterized by spruce and northern hardwood types. Areas not owned by the School, but upon which it has extensive facilities for instruction and research, are: (1) the Eli Whitney Forest of the New Haven Water Company, covering 22,000 acres in southern Connecticut; (2) the Great Mountain Forest, owned by E. C. Childs and F. C. Walcott near Norfolk, Conn., covering 5,500 acres with a wide variety of forest types, both hardwood and softwood; and (3) the lands of the Urania Lumber Company at Urania, La., in the southern pine country.

Thus three of the six areas lie in Connecticut hardwood forests, yet they are sufficiently different so that each one of them supplements the others in the character of problems furnished and in opportunities for work by the School. The Union Forest and the Great Mountain Forest were formerly much alike in character, since they both lay in a transition zone between the oak types characterizing southern Connecticut and the more northerly conifer and hardwood types. They both have a wide variety of hardwood types ranging from pure oak through birch, beech, and maple; both have extensive stands of eastern hemlock and good representation of white pine. The hurricane of 1938, however, removed all resem-

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blance in that the Union Forest was almost completely wrecked and the Great Mountain Forest was left unharmed.

The present bulletin deals with the Union Forest. It summarizes the past history of the area in general from the time of first settlement and treats the history of the Forest in detail; it relates the impact of the great hurricane and describes the present conditions. In compiling this report, the authors have drawn extensively upon the works of the several local historians (1, 8, 11, 12, 13, 18) and have made use of information and statistics gathered by Nathan D. Canterbury, who was Director of the Union Forest between 1930 and 1937, by Robert T. Clapp, who succeeded Mr. Canterbury and stayed until 1942, at which time he was accepted for service by the U.S. Navy, and by Basil A. Plusnin, the present Superintendent. Use is also made of surveys carried out by Mr. Myers prior to the transfer of the tract to Yale, and by Mr. Clapp who conducted the 1937 survey and started the post-hurricane survey in 1943 to be completed in 1944 by the present superintendent. A detailed descriptive survey (9), made by Robert W. Hess in the summer of 1941 is also drawn upon.

LOCATION AND ACCESS

IF one took a map of southern New England, drew on it a straight line between Hartford and Boston, and then plotted a point exactly one-third the distance from Hartford, this point would lie in the Union Forest. The Forest is a roughly rectangular area, 4 by 4½ miles in extent, lying in the towns of Ashford, Eastford, and Woodstock of Tolland County and in the town of Union of Windham County. It is readily accessible by motor transportation, less readily so by railroad. The new Wilbur Cross Highway, a portion of the planned superhighway between New York and Boston, touches upon the northwest corner of the tract, shortly before it by-passes the village of Union. This highway, together with the roads leading into it, forms the best means of access from the west, southwest, north, and northeast, particularly if one is interested in reaching the Forest headquarters. The southwest corner of the Forest is reached by state highway 89 and the eastern part by highways 91 and 198. The latter route is preferable if one desires to reach the summer camp area.

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The Central Vermont Railroad connecting Willimantic, Conn., and Palmer, Mass., passes through Stafford Springs, about nine miles west of Union. The New York, New Haven and Hartford Railroad between Willimantic and Worcester, Mass., passes through Putnam, about 10 miles to the east of North Ashford.

Directly adjacent to the Union Forest are several small settlements: Union on the northwest, North Ashford on the east, Eastford on the southeast, and Westford on the southwest. Further distant are more substantial communities. Nine miles to the west is Stafford Springs with a population of 3,401, according to the 1940 census; about 12 miles to the north is Southbridge with a population of 16,285; 10 miles to the east of West Ashford is Putnam with a population of 7,775, and 20 miles to the south is Willimantic with a population of 12,101. Still further distant lie the larger cities. Worcester, Mass. (population 193,694), is about 30 miles to the east of north; Springfield, Mass. (population 149,554), about 30 miles northwest; Hartford, Conn. (166,267), 30 miles southwest; and Providence, R.I. (population 253,504), 45 miles southeast.

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THE principal towns in which the Union Forest is located, namely, Ashford, Eastford, and Union, were among the latest, if not the latest, to become settled in eastern Connecticut, yet settlement dates back to the earliest part of the eighteenth century. With slight amendment, the words of Waldo (18) in reference to the Town of Tolland, a community lying only a few miles west of the Union Forest, can be applied to the towns being discussed. He states:

In looking back through the long vista of years since this town was first known, we can discover no incident of thrilling interest connected with its history. We can point to no spot where the white and the red man have met in mortal combat, nor where hostile armies have sought for vengeance in the bloody encounter. Nor can we find the footsteps of any distinguished personage upon its territory who has attracted the gaze of the world by his deeds of daring or acts of self-devotion. The history of Tolland, in short, is not calculated to interest the marvelous, nor produce wonder and astonishment in the reflecting, but like a gentle

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current, bears upon its quiet bosom facts worthy of our notice and which may afford us both interest and amusement.

One is forced to amend Waldo's statement regarding "distinguished personage" if applied to these towns, since even a casual survey of local genealogies will reveal that they have yielded more than their due share of scholars, divines, inventors, warriors, industrialists, and business men. It is quite true, however, that many of the reputations were not gained in the local communities, but nevertheless such was the origin of the talent.

The history of the Union Forest is one of long-continued land use, including agriculture, grazing, lumbering, hunting and fishing, mining, and recreation. It is one of relatively rapid population growth and decline; one of use and abuse of the natural resources; one of the persistence of the forest to maintain itself, since it came back again and again in spite of every adversity, such as logging and re-logging, stripping for agricultural purposes, fire, disease, and hurricane. After two centuries of use, it is still a forested country, with a percentage of area under forest substantially exceeding that of a century ago.

The first white man to traverse the area did so during the earliest days of settlement in Connecticut. It is reported (8) that in 1633 two parties left Boston with the intent of establishing a new settlement on the Connecticut River at what is now Hartford. One party went by ship, the second party under John Oldam went overland by the old Indian trail known as the "Connecticut path" which passed just south of where the Union Forest is now situated. It is quite definitely established that in 1636, a large number of Cambridge settlers sold their land, and traveling over the old Connecticut path, which entered Connecticut at what is now Woodstock, crossing the upper part of Windham and Tolland Counties, made their settlement and took up land at Hartford. They did not tarry in the wilds of the hills but sought a home in fertile river bottoms. It was almost three-quarters of a century later when the pressure of excess population forced the bolder spirits to move out into the wilder country. They came in from north, east, south, and west. Woodstock, on the eastern bounds of the forest, was settled by settlers from Massachusetts; Windham to the south by settlers

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from Norwich; and Tolland to the west by overflow population of Windsor, near Hartford.

Before the advent of the white man, the northeastern part of Connecticut was occupied by the Nipnet or Nipmuck (Fresh Water) Indians. The present towns of Woodstock, Union, Ashford, and Eastford were a part of the Wabbaquasset or mat-producing country, named after the wealth of flags in the swamps from which the Indians made mats and baskets. The Wabbaquasset Indians were a peaceful tribe, giving allegiance to whatever major tribe was currently in power, whether Mohegans, Narragansets, or even stronger Nipmucks. The region was never heavily populated by the Indians, only one settlement being known, that near the present location of Woodstock village in the most fertile part of the country. The only other mention of Indian settlement is a winter camping ground in what is now known as Boston Hollow, to which the Sound Indians went, probably for the hunting. Hunting was of course the major aboriginal use of the country as a whole, although in the fertile section of Woodstock some corn and beans were planted.

The first transfer of land, involving Windham County, was made in 1653 by Allumps, or Hyems, alias James, to John Winthrop, later Governor of Connecticut, in the southernmost part. The second transfer, which is of more concern, was made in 1684 to Captain James Fitch and included the entire Wabbaquasset country encroaching in small part on Winthrop's grant. Uncas, the Indian chief who had been of substantial assistance to the English in the Pequot War, although a Pequot himself, by right of conquest had laid claim to all these lands, which claim was recognized by the Massachusetts court. On his death he passed his lands over to his sons Owaneco and Joshua, the Wabbaquasset country going to Owaneco. The latter proved himself to be incompetent and consented to have Captain James Fitch appointed as his guardian. Fitch's purchase was soon consummated and was confirmed by the General Court of Connecticut.

The Massachusetts colony, however, had also a very definite interest in at least part of the Wabbaquasset country, since in 1642 it had hired two surveyors (Woodward and Saffery) to run its south boundary in accordance to the Royal grant. This line was supposed to run west from a point 3 miles south of the southernmost part of the Charles River. As related by Ellen D. Larned (11), the starting

point was chosen on Wrentham Plain; the surveyors then took a sloop down along the coast, through Long Island Sound, and up the Connecticut River to establish the end point in what is now Windsor, Conn., 10 to 12 miles south of where it should have been. It is not recorded how or if the line between the two points was run, but it is definite knowledge that when the New Roxbury "Go-ers" came to run out a new township, which was to be Woodstock, they could not find the line and later found that they had lapped two miles over the boundary into Connecticut. The location of the Massachusetts-Connecticut boundary was to remain a subject for dispute for the next century and a half.

As soon as Captain Fitch got possession of the land he threw it open to purchasers. Apparently he tried to dispose of large tracts to colonies and towns rather than to sell in small lots to haphazard settlers. His first sale was made in 1686 to Roxbury in the colony of Massachusetts. The area was to be one of its own choosing in the Wabbaquasset country in Massachusetts. Thirteen pioneers or "Go-ers" were appointed to select the area, which they did forthwith, selecting an area which they called New Roxbury after the mother town, but which was soon to be called Woodstock. As noted above, they could not find the Woodward-Saffery line and went over into Connecticut at least two miles. Their first acts were to erect a barracks for future settlers and a sawmill. This was done in 1686 before they returned to Roxbury to make their report.

It was at this time that Sir Edmund Andres was appointed Governor of Massachusetts. Immediately upon his arrival in 1686 he withdrew all the charters and privileges of the colonists and declared void all purchases from the Indians. Under his administration, the first settlers of Massachusetts, even those who had possessed their lands for 50 years or more, were required to obtain new deeds at considerable expense. The New Roxbury settlers were not so troubled, but nevertheless felt quite insecure.

Captain Fitch, owing to the lack of clarity in his title, the action of Sir Andres, and other personal reasons, became less active in trying to dispose of his land. In 1695, however, as the result of a court judgment, he was required to transfer a tract of land 4 miles square in the southern part of the present Eastford County to Simeon Stoddard. No settlement ensued immediately. In 1706 the General Court of Connecticut decided to have the country surveyed and

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opened to settlers, and Fitch, hearing of this, immediately sold a tract 5 miles by 3 miles in dimension in the southern part of the present Ashford County and later the remaining area of 21,400 acres to James Corbin of Woodstock. A protracted conflict between the Government of Connecticut and the various purchasers and claimants followed. Title to the Stoddard tract was early confirmed but not to the rest. Corbin created a Company, which surveyed out his land as rapidly as possible and offered it for sale. The first settler in Ashford came in 1710 from Woodstock, taking 100 acres at the site of the present Warrentonville and on the Connecticut road, the old thoroughfare for travel between Boston and Hartford. Within six years time, 40 families settled in Ashford.

The settlement at Woodstock in 1686 was the very first in Windham County, but was shortly followed in 1688 by Windham, where Willimantic now lies, and later by Plainfield (1699), Coventry (1700), Mansfield (1703), Ashford (1710), Stafford (1718), and Union (1727). The towns in which the Union Forest lies therefore date their founding back to the years between 1686 and 1727.

The life of the settlers was by no means an easy one, remaining difficult for many years. King Philip's war in the late 1690's did much to delay further active settlement. The inhabitants of Woodstock felt the interruption keenly. Population fell off, public affairs were neglected, highways grew up to brush, and the mill-house became dilapidated. The first emigration from Woodstock, but by no means the last, ensued.

James Corbin was one of the notable men of the community of this period. His activity was not confined to Woodstock but spread out through all the neighboring towns, particularly those to the west, such as Ashford. He and his sons (11) "dealt largely in furs, they collected turpentine from the adjoining forests, they took in the surplus produce of the planters, exchanging them and any marketable commodities for liquor, ammunition and other necessities in Boston." The Indians furnished most of the skins and undoubtedly many of them were taken from Union Forest lands.

The subdivision of Woodstock is of more than passing interest, since the whole town in various years (1695-6, 1713, 1715) was divided into ranges running north and south with widths usually of 160 rods but running up to 172 rods and provision for range-ways between ranges. The ranges themselves were divided into lots

by east and west lines, blocking off rectangles of varying width. There is little in the present ownership pattern to indicate these original systematic divisions. Union was also originally subdivided into rectangular tracts, but not quite so methodically as Woodstock.

The boundary controversy between Connecticut and Massachusetts demands further attention. Connecticut had confirmed the Woodstock deeds in 1694 although Massachusetts still claimed the town. Since the Woodward-Saffery line was admittedly faulty, the two colonies agreed to a compromise in 1713, which placed the towns of Woodstock, Enfield, and Suffield (the latter two on the Connecticut River) under the jurisdiction of Massachusetts, but all the remaining towns up to a corrected boundary, as it should have been run originally, under the jurisdiction of Connecticut. Woodstock later became dissatisfied by this arrangement and began to petition for acceptance into Connecticut, basing its claim in part on the fact that the King had never recognized the boundary agreement and that the first line was wrongly located. The Connecticut Assembly finally agreed to accept the petition (1749) and took Woodstock into the Colony. Massachusetts, of course, was not a party to this agreement and kept up the struggle through the Revolutionary War. The dispute was not finally settled until 1834, more than a century after the period under discussion.

The lands in the present town of Union came to Connecticut under the 1713 agreement and were known as the "Union Lands" or sometimes "Union Right." In 1719, the General Assembly of Connecticut appointed a committee to sell certain lands, the derived funds to go to Yale College, then a small struggling institution just moving to New Haven. The only previous claim to lands in Union that can be found is one dated 1657, wherein the General Court of Massachusetts awarded a tract of land to Captain Thomas Clarke of Boston as a reward for public service. This tract lay on what was then called Ocquebituque hill, or what is now Lead Mine hill, on the town line between Union and Ashford and directly adjacent to the western bounds of the Yale Forest. As the current name signifies, the tract was awarded for its "lead" mining possibilities, but there was no mining activity until after the settlement of the town three-quarters of a century later. In the Revolutionary War, 400 pounds of so-called "lead," but probably graphite, were taken from the mine.

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The Union land committee sold the town on July 1, 1720, at a price of 307 pounds to twelve proprietors, all from Windsor, Connecticut, with the optimistic reservation that a fifth part of all the silver and gold ore that may be found on the tract must be saved for the King and his successors. The tract was divided into 13 shares, one share for each proprietor and one to be held in common, but only one of the proprietors is known to have actually settled on the land. The bulk of the rights were sold as fast as possible to settlers and speculators, and Union joined the adjacent towns as a field for great land speculation and frequent ownership change. The first settler arrived in 1727. In 1729 the first subdivision of land was made in the prospective village location and further settlement proceeded. The town of Union was the last in northeastern Connecticut to be settled. It was incorporated in 1734.

In 1726, the County of Windham was established from parts of Hartford and New London Counties and in 1785 Tolland County was formed from parts of Windham and Hartford. When Woodstock was recognized by the Connecticut Assembly in 1749, it was added to Windham County. Union was the only one of the four towns affected by the creation of Tolland County and was transferred thereto.

Thus at the end of the first quarter of the eighteenth century one finds each town settled and the political structure progressing rapidly. The state of development of the towns varied considerably. Woodstock was the most prosperous, but only relatively so, boasting as early as 1718, of 100 houses and barns, 11 mills of various kinds, such as sawmills, gristmills, and tanneries, and 1,281 acres of agricultural land including pasture. It was a center of influence, which spread over neighboring towns. Ashford was struggling along with two main centers of settlement, one in the east and one in the west; this at a later date (1847) was to lead to dividing Ashford into the two towns of Ashford and Eastford. Life was so difficult in Ashford that the town was exempt from colony taxes for many years, up to 1732. Union was just starting up and as yet had not made much impression.

The period from then on through the Revolutionary War was one of slow development, largely an agricultural phase with the gradual introduction of home industry and local manufactories. The typical procedures for the settlers was to clear, burn, and fence a small

plot of woodland annually, and gradually increase the cultivated acreage. Agricultural development was strictly limited by the very nature of the ground and active emigration from such pressure points as Woodstock again took place in 1747-1755, many inhabitants going on to western Massachusetts and New Hampshire and later in 1760-1775 to Vermont and New York. Wheat, rye, corn, barley, flax, and hemp constituted the chief agricultural crops. Cattle and sheep grazing was common. Local manufactories catered to supplying the needs of the population, producing such items as potash, and pearlash, coarse pottery, and domestic fabrics such as linen and woolen goods. In 1760, the first iron works came to these towns, the New Roxbury Iron Works located at Black Pond a short distance east of the Yale Forest. Local deposits were worked for the raw material.

Location on the Connecticut Road helped substantially in the development of the country. Ashford, which had such a hard time in getting a start, catered particularly to the overland trade and by 1760 had several taverns, saw- and gristmills, and a tannery or two. Like Woodstock, Ashford also felt the pressure of over-population and emigration set in about this time, inhabitants going further west, some to New York and Vermont. Shoe manufacturing in the home, which was destined to take a prominent place in the future local industry, made its appearance. The silk business also was founded about the year 1760 by the introduction of mulberry trees. President Ezra Stiles of Yale was a dominating figure in the promotion of this particular industry. It is recorded (8) that the neighboring town of Mansfield had reached a production of 390 pounds of raw silk by 1830 and further to 25,000 pounds by 1850, whereafter the business died down, owing partly to a disease which attacked the trees, but also undoubtedly to the great expansion of transportation systems, which occurred about that time, and the consequent dying out of home industry.

Following the Revolutionary War, a new period of development profoundly changed the character of activity. Cooperage shops, brick and pottery manufactory, a gold and silver smithery and brick yard directly adjacent to the north and east bounds of the Still River tract of the Union Forest, boot shops, blacksmith shops, a fulling mill, a cotton and wool factory, and a number of taverns and even more grist- and sawmills were to be found in Wood-

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stock. Trade began to boom and with it the demand for more and better roads. The lower turnpike from Boston to Hartford was authorized in 1796 and passed through the village of Ashford. It was abandoned in 1840. The upper or central turnpike was built in 1826-7, took over much of the travel on the lower turnpike, and became an important thoroughfare. This turnpike passed through Woodstock and North Ashford, traversing the Union Forest area. Remnants of this road are still found near the site of the School camp. Heavy stage travel and the overland mails from New York to Boston took this route for the first time in 1837. A turnpike from Woodstock to Stafford and Sommers was built in 1808, as an extension of the Woodstock-Providence road, and crossed the northernmost part of the Union Forest. The activity in road construction was a boom to the country. Woodstock, Ashford, and Union prospered as a result, but not until after still another exodus of population from Woodstock shortly after the Revolutionary War. For example, the Census of Windham County taken in 1800 showed a decrease in population from 1790 and only a slight increase since 1780, with Ashford one of the heavy losers.

New manufactories had come in and were given further impetus by the development of appropriate machines. Carding machines introduced to Woodstock in 1806 caused a profound change. Home-grown wool and flax lost their importance and imported cotton became prominent. In 1807 the first cotton factory was established in northwestern Connecticut and soon nearly every house had its loom, weaving cloth for the factory. Manufacture of paper started in 1810 at New Boston and continued until 1831, when the building was converted to a cotton mill. In this first quarter of the nineteenth century, Woodstock claimed two blacksmith shops with large trip hammers, two wheelwrights, one goldsmith, one carding machine, one fulling mill, one oil-mill, seven gristmills, twelve sawmills, two distilleries, cloth factory, tanneries, brick and pottery works. Ashford had six gristmills, nine sawmills, five tanneries, four carding machines, and a tinware factory. Carriage making became a thriving industry in Woodstock, starting in 1835, using at first the building facilities of the old foundry which by this time had been abandoned. Agriculture and stock raising were still important, being stimulated by the expanding manufacturing development. The shoe industry increased at a rapid pace in all three towns. Shoemaking

at the time was largely a domestic activity, the tanneries and stores acting as distribution centers, parceling out the work to the local inhabitants. Its importance can be indicated in Woodstock's reported production (11) of 5,561,580 pairs of shoes and boots in 1845 with about nine thousand people participating, and in Union's country store business of home shoe making of \$100,000 a year. The Woodstock figure must be looked upon with a great measure of doubt, however, since it must cover a number of years, or a number of towns, or even a combination of the two, Woodstock having a population at this time of less than four thousand people. Tub and pail factories, cooperages, twine and cotton batting production, both at home and at mills, and stave manufacture in Union attest to further widening of commercial activity. Palm leaf hats manufactured at home, and axe handle production in a factory at Boston Hollow were other industries. No period of the history of these towns shows more activity and more diversified effort than the second quarter of the nineteenth century.

The era of prosperity did not last long. First of all, new railroads, from Norwich to Worcester in 1840, to Willimantic in 1849, to Stafford Springs in 1850, and later the extension to Boston of the Middletown-Willimantic line in 1870 took all the transport business off the turnpikes. Second, the development of better machinery, the concentration of manufacture in larger and larger units, located along major streams and along railroads, brought home production and small factories to a stop. The home shoe industry vanished. It had produced rough brogans for the southern trade and could not compete with machine-made shoes. With the decline in this industry came also a changed emphasis and decline in the live stock business. Ashford suffered particularly; formerly on the main route of Hartford to Boston travel, it now became isolated. In addition, in 1847 it lost its eastern half, from which the town of Eastford was established. Eastford remained active for some time, and as late as 1880 is noted (10) as being a brisk, young town. It still presents the busiest appearance of any of the old small towns, adjacent to the Forest. Ashford however did get another new temporary industry in that a glass works was established in 1857 at Westford, which became the largest industry ever established in the town and gained considerable local renown.

The coming of the machine age is the primary reason for the

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rapid development of Windham County as a whole, but it was a development made at the expense of such towns as Woodstock, Ashford, Eastford, and Union, which were forced to turn back more and more to agricultural activities and its accompanying limitations. As a consequence, while the population of the County and the State gained rapidly, that of these hill towns regressed rapidly, until at the present time they have again reverted almost totally to the rural state, with the former humming communities converted to pleasant roadside villages, or even completely abandoned, serving now principally as gasoline supply points for the traveler and local community centers. Farms were rapidly abandoned and agricultural land grew up to brush and trees. A renaissance of agriculture set in shortly after the beginning of the current century with the advent of foreign-born immigrants, as is described later in this report.

An interesting picture of contrasts would be obtained by the present traveler, if he took the travel notes of Oliver A. Hiscox (13) and traversed the same route. Hiscox made his trip in the 1880's and passed from Union around the north and east edges of the Still River tract of the Yale Forest into Woodstock Valley and then east through the rest of the town. In regard to the first part of the trip, which is most intimately associated with the Yale area, he says:

"I drove out from the pine forests of Union and the first thing in Woodstock that attracted my attention was the Lyman Sessions house and mills; it was easy to see that this had been the center of considerable activity; it had been the life-long home of Lyman Sessions. Here he had sawmill, gristmill, carried on a general lumber business; kept a country store; engaged in the shoe manufacturing business. . . . Nearby is the site of Lowdin Arnold's silver-smith shop. Silver spoons may still be found in Woodstock which he made more than a hundred years ago. David Hiscox had a brickyard near Arnold's shop. The bricks for the house in West Woodstock, known as the Andres Martin house, were made there in 1882. I passed over the old Boston and Hartford turnpike to Green's Tavern on the west side of Black pond. This was a noted hostelry during stage coach days, and still known as Green's Tavern for miles around, Caleb Green now living here and carrying on the large farm connected with the early hotel. His father had run the hotel before his day, buying it from Daniel L. Healy, who came to Woodstock from Dudley, Mass., about 1820. Turning south I passed the

venerable old chestnut tree that for a hundred years has been a landmark along the way. I next passed the schoolhouse, only about twenty feet square; it was one of the red schoolhouses of town, but now had received a coat of brown paint. Next I came to a large two-story house that has sheltered at least three generations of the Dewing family, Ebenezer being the last of the line to live there. . . . Hiscox mills just south owned by Alba Hiscox since 1836. Mr. Hiscox ran the sawmill, shingle mill, and gristmill for over fifty years. These mills occupy the site of Woodstock's earliest attempt to utilize the iron ore deposit of the town. A furnace was in operation here as early as 1760. Mr. Hiscox was also interested with his brother in the manufacture of shoes, making heavy brogans called 'stogeys' which were shipped south for the slave trade. Joseph Hallock runs the tannery just below the gristmill, this is the tannery built by G. and Z. Wight. . . . The Lyon family were among the earliest settlers in this part of the town, building saw- and gristmills near Black pond. The dam at the outlet of the pond was built by slaves of Ebenezer Lyon and is the only known specimen of Woodstock slave laboring existing." And so on through the township, but already covering the roads lying closest to the Union Forest.

By retracing the identical trip in 1945, as the authors have done, a different picture is obtained, not only contrasting with the past conditions as related by Hiscox, but with conditions existing at his time and shown on a contemporary map included in Bowen's book (1), dated 1883. One no longer "drives out of the pine forests of Union." The present stand is heterogeneous, characterized more by hardwood than pine, but with occasional large and branchy white pine here and there and a fair amount of pine reproduction underneath, threatened with domination by the hardwood canopy. The Sessions and Arnold developments have practically disappeared. Only two small cellar holes can be found surmounted by huge clumps of lilac, which appear to be attempting to cover up the signs of past occupation, but by their very strangeness forming a living monument. Two huge gravel pits, dug out recently to furnish materials for roads, have probably removed the traces of other buildings and the brick yard. Green's Tavern still stands in good repair, though no longer a tavern. Of course the "venerable old chestnut tree" is gone. Not even a large enough stump remains which would permit one to identify its location. The old red schoolhouse with its

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coat of brown paint stands no longer. Only a low ridge of stone in the form of a 20-foot square covered by soil and sod remain to indicate the site. The "large two-story house" no longer looks large in comparison to newer dwellings, but it still stands and is still inhabited. The Hiscox mills have almost vanished, although the dwelling houses have not. The dam is still in place although badly breached at the spillway; the foundations of the various mills and the tannery have been washed out or removed and only small sections of the original foundations remain.

The pattern of change as revealed by the above comparison is typical of the general history of this portion of northeastern Connecticut. Settled originally for purposes of agriculture and stock raising, the inhabitants found the procurement of a livelihood so difficult that they ventured into many forms of industrial pursuit. Small mills and manufactories of many kinds sprang up plentifully throughout the entire country and operated through a relatively long period, only to meet their end with the development of industrial centralization. Subsequent deterioration was rapid. Mills were abandoned, dismantled, or fell to ruin. Population declined and a retrogression in development ensued, reaching the depth at the turn of the present century. Introduction of new peoples with a willingness to work under hard conditions and with a vision and spirit probably akin to that of the original settlers of almost 200 years previous have produced a partial restoration, but in agriculture and stock raising only. Industry, except for sawmilling, has gone and may never be restored.

Of all the many human activities in the struggle for livelihood which have existed in these towns, the original pursuits of farming, grazing, and lumbering have lasted the longest, even to the extent of becoming almost the exclusive ones. Each has had a varied history, changing almost constantly in scope and character, but they have endured and will undoubtedly last much longer. The story of lumbering is naturally of particular interest to this treatise. Advent of white settlement brought with it immediately the construction of sawmills. Up to the middle of the nineteenth century, they were located practically always on brooks and rivers, where water power could be used to drive the saws. The saws were of the up-and-down type, with only one blade, and production was low, probably one to two thousand board feet a day. Operation was strictly seasonal,

being confined to those portions of the year when water was high, probably two to three months. The production was for local consumption and entered little into trade with distant communities. It was so local in fact that mills sprang up all around the country. The total annual production for sawmills in the Town of Woodstock, for example, is estimated (13) to have amounted to only 50 thousand board feet per mill between 1820 and 1830. Lincoln (13) tells of nine sawmills in Ashford in 1818; Lawson (12) of 13 sawmills in Union township about the middle of the century, and 12 sawmills in 1820 in Woodstock. Much of the work was undoubtedly custom sawing, the farmers hauling in logs to be sawed at the mills and the lumber returned for their own use.

During most of the eighteenth century the woods were considered as a barrier to agriculture and substantial areas of forest land were cleared and the product disposed of in the simplest fashion, namely, by burning. The advancing commercialism of the next century brought about a wiser use; in addition, agriculture by this time had reached the limits of expansion, all suitable lands having been cleared and agriculture being subordinated to home and central manufacturing. Prior to the middle of the century it is said (13) that the settlers cut only the largest trees, "practicing forestry as recommended by forestry schools today." The development of the circular saw and the application of steam power to drive the saws brought about a great change in this industry. This occurred about 1870. The operation needed no longer to be seasonal since one did not have to depend upon the height of the water. The logs did not have to be hauled long distances to the mill; the mills could go to the woods; the cut was no longer one to two thousand feet a day, but increased to 20 thousand board feet; selection cutting was abandoned and clean cutting was practiced; improved transportation facilities, road and railroad, permitted shipping out far from the source of supply. The extent of coverage which logging for these mills accomplished can hardly be sensed by the present aspect of the forest. The Union Forest alone shows evidences of four dozen or more of these temporary settings. At the beginning of the present century little virgin forest remained, except in scattered remnants of old, defective trees too poor for the saw. Some of the stands, particularly those having high percentages of chestnut, were even being cut for the second time. Most of the present stands, at least

POPULATION GROWTH, DECLINE, AND CHANGE

prior to the hurricane of 1938, dated from this period of clean cutting in the late nineteenth and early twentieth century, which was simultaneous with the period of agricultural land abandonment and population depletion.

POPULATION GROWTH, DECLINE, AND CHANGE

AN interesting and significant trend in population is revealed by census statistics (4), of which Table I abstracts those which pertain most directly to the situation. The first census available is for the year 1756 and the second for 1774, while official United States censuses date from 1790 on at 10-year intervals. For the state as a whole the increase in growth rate was rapid for the period up to 1790, then gradually reduced and reached a relatively constant geometric rate of increase of 0.52 per cent per year from 1790 to 1840. Following this, owing to the centralization and expansion of established industry and the introduction of new industries into the State, the rate increased strikingly, maintaining a level of about 1.84 per cent up through 1930. The rural population by itself increased at a somewhat slower geometric rate for the period 1790 to 1840, being 0.32 per cent a year, followed by a rate of 0.95 per cent between 1840 and 1870, while the state population as a whole was undergoing its rapid expansion. Rural population remained almost constant (0.15 per cent rate of increase) for the following 30 years or more, followed again by a comparatively rapid increase (1.22 per cent), particularly from 1910 on when rural living became more and more popular for city workers.

The population of Tolland County stayed around 14,000 between the years 1790 to 1820 and then gained steadily up to the present time, maintaining an average geometric rate of growth of close to .59 per cent per year for the entire 150 years. In Windham County, population remained fairly constant around the 29,000 level between 1790 and 1840, increased rather rapidly for the next 40 years, and then maintained a slower rate of increase lasting to the present time; over the whole 150 years the rate of increase averaged 0.45 per cent per year.

While the populations of Windham and Tolland Counties on the whole were increasing throughout much of the period, those of the four towns in which the Union Forest lies followed a different pat-

tern. In spite of the ever-increasing population of the state, both urban and rural, and of the two counties, each of the four towns reached a peak of population during the middle of the nineteenth century and then fell off more rapidly than they had built up. Since Eastford and Ashford were once a single town, the statistics of the two should be combined if the true trend is to be observed. These declines continued to about 1910 in Woodstock and Ashford combined with Eastford, when the populations apparently stabilized. In Union the decline continued to 1930, followed by a recovery. However at the present time Union has less than one-half the population it had in 1756 and less than one-third of that at the time of its peak development. Woodstock is down at its 1770 level, while Ashford and Eastford combined are at about the 1756 level.

Initial rapid growth of the towns is easily explained if one takes the trouble to survey the family statistics, such as listed by Lawson (12), wherein it is seen that a family with four children in the early days was truly a small one, and one with eight to ten children was by no means rare. Casual survey of the land itself would convince one that a saturation point must have been reached rapidly and that exodus to other areas was soon essential. Several emigrations have already been mentioned. Minor movements in the eighteenth century were followed by a major exodus in the 1820's. Spurred on by the opening up of main highways, the development of railroads, and the centralization of industry in major cities, all of which took place during the mid-nineteenth century, the exodus continued, being further accelerated during the agricultural depression and the opening of western lands which followed the Civil War.

The early population was almost totally of English blood and remained so for a long time. In Woodstock in the 1870's a minor immigration of Swedish workers took place, to work in the cranberry bogs then being established. Union is unique in that it was settled by Scotch-Irish, probably the only settlement of this national strain in eastern Connecticut. Only within the current century did a radical change take place, when substantial influx of central Europeans settled in the towns and began to rework the farms which had long been abandoned or were on the verge of abandonment. Bohemians came in first, then Poles, Russians, Hungarians, and Slovaks.

POPULATION GROWTH, DECLINE, AND CHANGE

TABLE 1. POPULATION STATISTICS FOR SEVERAL TOWNS IN TWO COUNTIES OF NORTHEASTERN CONNECTICUT

Date of census	State population		County population		Township population			
	Total	Rural	Tolland	Windham	Union	Woodstock	Eastford	Asbford
1756	139,612		(9,837)*	(17,880)	500	1,366		1,245
1774	197,842		(12,998)	(25,558)	514	2,054		2,241
1782	208,850				552	2,052		2,286
1790	237,946	230,776	13,251	28,821	630	2,431		2,563
1800	251,002	238,280	14,319	28,208	767	2,463		2,445
1810	261,942	246,001	13,779	28,611	752	2,654		2,532
1820	275,248	254,444	14,330	31,684	757	3,017		2,778
1830	297,675	269,828	18,702	27,082	711	2,917		2,661
1840	309,978	271,026	17,980	28,080	669	3,053		2,651
1850	370,792	311,471	20,091	31,081	728	3,381	1,127	1,295
1860	460,147	338,026	20,709	34,747	732	3,285	1,005	1,231
1870	537,454	360,301	22,000	38,518	627	2,955	984	1,241
1880	622,700	361,982	24,112	48,856	539	2,639	855	1,041
1890	746,258	366,405	25,081	45,158	431	2,309	561	778
1900	908,420	364,665	24,523	46,861	428	2,995	523	757
1910	1,114,756	382,959	26,459	48,361	322	1,849	513	668
1920	1,380,631	444,292	27,216	52,815	257	1,767	496	673
1930	1,606,993	475,133	28,659	54,086	196	1,712	529	726
1940	1,709,242	551,080	31,866	56,223	234	1,912	496	704

*Parenthesized items are estimates of populations of townships in Hartford and New London Counties, which were later incorporated into Tolland and Windham Counties.

CONSOLIDATION OF TRACT

IN 1906, at the time when population had reached its low ebb and just prior to the influx of the new nationalities from central Europe which was to stop further decline, Mr. Myers made his first purchase in the town of Union. Incidentally, in the same region at approximately the same time (1905) the State of Connecticut began to establish its second oldest existing forest, the Nipmuck Forest. Continued abandonment of agricultural lands and further emigration of the native population gave Mr. Myers frequent opportunity to add to his initial purchase, so that within a decade-and-a-half the privately acquired area reached a total of about 6,000 acres and by 1930, when the bulk of the property was deeded to Yale, of about 8,000 acres. During the period from 1906 to 1930, the activities on the acquired land were varied, centering primarily on the use of the tract for a summer-home residence and for a game refuge, but also serving the purpose of furnishing facilities for studies in forestry and for the training of forestry students. Active logging was carried on from time to time to help carry the expense of holding the tract. Many abandoned fields were planted to white pine and red pine in various years a total of about 150 acres being planted.

Because a permanent all-year staff of workers was kept on the forest, the tract was benefited by an intensity of fire and game protection not practiced on neighboring lands. Roads and trails were kept cleared, new roads constructed, a fire tower erected on Walker Mountain and the area patrolled throughout the entire year. Old dams were maintained and a few new ones built to encourage bird and fish life.

A major tragedy during the second decade of the present century was the killing of the most valuable species in the forest by the chestnut blight. Chestnut salvage continued for many years, beyond 1930, and even at the present time there are opportunities to harvest dead chestnut from the more remote parts of the forest.

In 1906, the U.S. Forest Service made use of parts of the area by locating four permanent sample plots, two of which were in pure chestnut type and two on clear cut pine lands. Each year from 1917 to 1922, the tract was the location of the spring field work of the junior class of the Yale School of Forestry, during which period

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over 4,000 acres were cruised and type-mapped with main emphasis on evaluating the possibilities of the tract for pine production and on assembling data for more intensive management practice. The field type sheets were assembled into a general map, starting in 1919, and kept up to date when additional cruises were run. A complete set of these maps is kept in the files of the School. It is interesting to note that, in 1922, the pine acreage amounted to 612 acres or 15.2 per cent out of the total of 4,026 acres cruised, and the pine volume to 4,500,000 board feet. At the present time, owing partly to cutting, but principally to the hurricane destruction, the pine area constitutes only 7.3 per cent of the total and the pine volume is only 1,800,000 board feet.

In 1929, a general survey of the tract was made, at which time it was estimated that the forest contained 27,500,000 board feet of timber, of which 32 per cent was white pine, 22 per cent hemlock, 27 per cent oak, and 19 per cent other hardwoods. It was in this year that Mr. Myers made the proposal to transfer a large proportion of his lands to the Yale School of Forestry, an offer which was accepted by the Corporation of Yale University on December 11, 1929. Mr. Myers' continued interest is evidenced by further aid and contributions toward a detailed boundary survey, a further development of tract improvements, and acquisition of other desirable interior holdings.

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GENERAL

THE first transfers of land to Yale occurred in 1930, others in 1932 and the last in 1934, by which time the title to about 7,500 acres of the total of approximately 8,000 acres had been deeded to the University. Included with the gift of land were 18 old houses and their outbuildings in various stages of repair, four sawmills, of which two were water-power mills, and six horses. The livestock was soon disposed of by sale. Mr. Myers retained the ownership of about 500 acres in the north central part of the tract, where his summer residence was located, and also reserved certain modest hunting and fishing rights. A graduate forester, Nathan D. Canterbury, was appointed in 1930 to help effectuate the transfer,

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to act as agent of both parties in the control of the properties, and to organize the Forest for production.

Yale's initial object in managing the tract is well expressed by Dean Graves in a statement to the Charles Lathrop Pack Foundation (7), in which he says in part: "The first purpose is to demonstrate forest management in all particulars for the benefit of owners of forest estates. The School has the challenge of business as well as technical management of diversified resources, of protection, of marketing of products, and other problems which offer peculiar opportunities for demonstration of features of management."

The first job was therefore one of organization of a forest property and business, to which much of the time in the succeeding eight years was devoted. The most immediate tasks performed were the assemblage and coördination of the various ownership maps and the running of accurate transit surveys over the major routes of travel on which to tie these maps. Retracement of all the original bounds was out of the question, since, as is the case in many portions of the hilly country of Connecticut, exact retracement is difficult, owing to the disappearance of original corners, forcing the establishment of new corners by litigation, or more commonly by mutual agreement and historical hearsay. Intensification of the fire-protection program proceeded concurrently and within a short time the assessment of the property for forest production and other purposes, such as wildlife and water development, student training, research, and the study of potential local markets took substantial time and thought. Particular emphasis was placed on public relations in the form of creating good will toward the Forest and making it an integral part of community life. In view of the fact that a sound appraisal of the entire tract was needed before a program of utilization could be recommended and started, the logging operations which were current at the time of first acquisition were closed down, thus reducing the revenue to a minimum for the time being. Even if the operations had been continued, it could not be and was not expected that the Forest be self-sustaining immediately, owing to the need of greatly increased expenditures for furnishing a sound basis for the new administration and the desirability of building up a depleted forest capital. The financing of these new activities was handled through several sources, such as revenues from forest products, assignment of part of the incomes from the

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Charles Lathrop Pack Fund (established in 1928) and the Childs Foundation (established 1929), plus further donations by Mr. Myers and others, including particularly Dean Graves.

The activities subsequent to the time that Yale acquired the tract calls for a more detailed discussion than contained in the above summary paragraphs and are divided into several logical categories in the following pages.

ACQUISITION

Further acquisition of forest land did not affect the total acreage to a marked extent, although it did place two properties, aggregating somewhat over 250 acres, under Yale ownership. These tracts were acquired in 1937 under gift from Mr. Myers and Dean Graves and were located desirably within the exterior bounds of the forest, close to the site that served for a number of years as the School's summer camp. A third area of 60 acres, now known as the "Graves lot," was acquired by Dean Graves at about the same time and is included in the statistics of area and volume, since it is under the nominal supervision of the Forest although still owned by Dean Graves. The total area was increased by these additions to 7,857.56 acres, at which figure it remains. An additional 2,000 acres seem to make desirable further acquisitions, but the program of adding new lands is now inactive.

ADMINISTRATION

After 1930, Mr. Canterbury, as director, assumed general responsibility over all forest affairs, being assisted by a resident superintendent, who for the most part had charge of the execution of the work program. The old Fairbanks house (see Frontispiece), said to have been built about 1732 and hence one of the oldest houses in the township of Union, was thoroughly repaired for use as forest headquarters and summer residence of the director. In 1932, when a demand arose for more substantial and central office space, such space was obtained in the First National Bank Building at Stafford Springs and held until 1942.

In 1937, following the resignation of the first director, a modified administration plan was adopted in that the new director also served in charge of all three school forests and maintained his winter residence in New Haven. The resident superintendent

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assumed greater responsibility by this change. Following the disposal of the bulk of the hurricane material, a policy of retrenchment was made necessary because of the prospective severe curtailment of logging operations for many years to come and the resultant anticipated heavy reduction in income. As it now stands, the position of director and resident superintendent have been combined into one job, with a technically trained forester maintaining year-long residence in the Fairbanks house.

IMPROVEMENTS

The improvement program following 1930 centered about road and trail maintenance and building repair or disposition. A substantial part of the time of two men was occupied in the task of removing brush along roads and trails, keeping ditches open and culverts in shape. The network of roads was sufficiently intensive so that no further new construction was required. State and town work resulted in the improvement of several roads under their jurisdiction. The new Wilbur Cross Highway greatly increased the accessibility of the Forest from the west and took 11.45 acres of forest land from two of its outlying northwestern lots. Relocation of a road at Ashford took an additional 1.3 acres. The hurricane barricaded the entire interior road system and to this date many of the formerly accessible trails are still not fit for travel.

The three dozen or more buildings and four mills acquired in 1930 constituted a special problem. Many of them had been abandoned for a decade or more. All of them were in a poor state of repair. In addition the need no longer existed to maintain most of them. Costs of repair in many instances were prohibitive and would not be warranted considering the low-rental incomes they would produce if made habitable. As a result only those houses in the best state of repair and those needed for the staff and employees were further maintained and improved. The remainder were left temporarily untouched and eventually removed. At the present time, six houses have been repaired and are occupied, while most of the others have been dismantled. One of the water-power mills was in such poor condition that it was dismantled and torn down. The second water-power mill, the Morse Mill, was repaired and reëquipped and served a useful purpose through the period of major disposal of hurricane material.

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INSTRUCTION AND RESEARCH

One of the original purposes of the Forest was to furnish effective instruction facilities for the School of Forestry summer camp. By 1933 two school buildings were constructed, located near the center of the tract near the Morse water-power mill, and the field work for incoming junior students was transferred from East Lyme, Conn., to the new headquarters. Within the next two years a third building was added and the housing facilities completed. The premises were used from 1933 through 1939, when owing to the excessive destruction of the forest stands, a change to new quarters at Norfolk, Conn., was made necessary. The decision was a hard one to make and might not have been necessary if the main emphasis in summer-term instruction had not been on mensuration and cruising.

The Union Forest is not essentially organized as a research forest, although a number of activities carried out from the beginning to the present time can be classed as of research character. A dozen permanent sample plots were on the tract when acquired, located principally in the white pine type. These plots were ruined, of course, in 1938. Special studies on utilization, such as on power equipment, new heating devices such as the Charwood heater, cordwood studies, recreational and wild life possibilities, ecology of laurel cover, botanical check lists, and other items complete the list. The area now furnishes excellent opportunities for investigation of the rehabilitation of forest stands after heavy damage with and without special silvicultural treatment and of returning to conifer types some of the area which had been taken over by hardwoods.

MAPS AND SURVEYS

Early surveys made by Yale School of Forestry students in the course of field training during the years from 1917 to 1922 covered over 4,000 acres of the land then held by Mr. Myers. Active cutting in subsequent years necessitated a new survey in 1929, just prior to the transfer to Yale, at which time it was estimated that about 25,000,000 board feet of timber stood on the area to be transferred. The estimates seem to have been somewhat high, since a resurvey made in 1930 on 1,500 acres, set the total volume 23 per cent lower than first estimated. Immediately upon acquisition by Yale, the

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ground work was laid for a thorough-going survey project by the establishment of a road transit survey with the placement of monuments at key points. The many ownership maps from different sources had to be reconciled and the exterior lines retraced and posted. Within a short time, that is in 1933, through coöperation with the Connecticut National Guard, supplemented by work of Fairchild and Company, a complete set of aerial photographs and mosaics was procured. These photographs together with the road traverse were used in 1937 in a ground survey to furnish the first detailed type map of the Forest. The survey was a line-plot cruise including timber estimating as well as sampling for growth. The type map was completed, but before much work had been done on the cruise estimate the hurricane of 1938 swept over the country.

Topographic mapping was a feature of the instruction given at the summer camp and during the course of the years a contour map of the forest, centering about the camp site, was gradually being built up. Control was readily coördinated into the state system after the Connecticut Geological Survey set up a triangulation station on Chandler hill in 1936.

In 1941, a descriptive survey of forest conditions (g) in each compartment of the Forest was made, thoroughly revising the type map of 1937 and placing it on a post-hurricane basis. Later in 1943 and 1944, a five-per-cent timber reconnaissance was run, forming the basis for the statistics of the present bulletin.

PROTECTION

Adequate protection from fire is the first concern in any forestry venture and was so conceived at Union. The property had long been well patrolled and staffed so that actual damage by fire had not been serious. As is typical in much of the hardwood country, critical fire conditions are apt to occur at Union during two periods during the year, one in spring and one in fall. The spring season lasts from the time that the dead leaf litter starts to dry out after the winter snows have disappeared until the leafy forest canopy is again well established and together with the ground vegetation increases the moisture content of the previous season's leaf cast. The fall season starts with the leaf fall and lasts until the heavy autumn rains and winter snows. In spite of the potential threat the actual fire danger has not proven to be quite as serious as originally

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feared. Effective control was secured by the almost daily patrol of the workmen and superintendent in the course of their work and by the purchase of ground-fighting equipment such as fire rakes, shovels, and back-pack pumps. The wooden fire tower on Walker mountain was manned during fire days until the State constructed a fire tower on Bald hill to the west of the Forest, which not only gave better coverage but was coördinated into the state system of lookouts. Coöperation with other land owners, such as the Quinebaug Forestry Company, and with the State was also an essential feature of the fire-protection program. During the fifteen years that the Union Forest has been held by the School only five small fires have been known to occur, none of them reaching serious proportions.

The hazards from other natural sources, such as wind, sleet, disease, and insects, has proven to be far more serious and in most cases protection measures are non-existent or inadequate. No measures could forestall the heavy hurricane damage of 1938. Little can be done to alleviate sleet damage (see Plate 7), which occurs frequently in southern New England forests and is undoubtedly a prominent factor in producing in trees the branchiness and low quality, so common in this part of the country. The chestnut blight could not be stopped and the Forest lost its most valuable species. Only with white pine blister rust has an effective protective measure been available, through the eradication of the alternate host, *Ribes*. This measure has been applied to the Union Forest through the efforts of the enrollees in the Civilian Conservation Corps about the year 1935. Later on, following the hurricane, the C.C.C. performed another valuable protection service by helping to dispose of the slash along roads and by constructing water holes for supplying water to power pumps and back pumps at convenient intervals. The gypsy moth and browntail moth remain potential threats, although fortunately they have caused little damage in the Forest, in spite of the fact that the tree species, considered to be their favored feeding grounds, are among the most common on the Forest.

UTILIZATION

The production of revenue through the utilization of all conceivable products is an essential element in the management of a tract of this nature. The degree of utilization must of course be

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commensurate with continued productivity and not bar further improvement of forest conditions and gradual increase of the forest capital. Just prior to acquisition by Yale, a crew of eight men under a foreman had been kept busy for a number of years, principally in logging and saw-milling. It was deemed advisable to dispense with the services of this group, pending an investigation of the forest resources and the markets for forest products. A small working crew of two to three men was substituted to keep up with essential maintenance work and to form a nucleus for supplementary labor when the demand arose from time to time. Small cutting contracts, such as for railroad ties, were taken on for the first year or two, and on the whole during the first five years, the cutting averaged only about 100,000 board feet annually. The national depression, which started in 1929 and reached its climax in 1932, had of course a pronounced effect and prevented a rapid rise in business on the forest. Total gross income, however, increased at an average annual rate of about \$1,000, reaching \$6,000 to \$7,000 by 1937. Much of the increase was due to the disposal of products other than stumpage on lumber itself.

An interesting variety of revenues was obtained during these years, as shown in the following list:

- Wood products
 - Stumpage
 - Logs
 - Sawed products
 - Boards, rough or dressed
 - Dimension
 - Timber
 - Pattern stock
 - Cross ties
 - Slabs
 - Shavings
 - Sawdust
 - Posts
 - Highway
 - Fence
 - Chestnut tobacco poles
 - Cordwood

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Other sources of income

House rentals

Pasture rentals

Hay

Sand and gravel

Evergreens

Furs

Fruit

Wrecking of old houses and outbuildings

Miscellaneous equipment

The old Morse water-power mill was repaired and converted to be driven by the power unit of a tractor, which came with the tract. In 1933 a small planer and matcher were added to the edger and circular saw already in use. It was in this year that the N.R.A. Lumber Code was drawn. The Forest applied for an annual cut of 410,000 board feet based upon the performance prior to acquisition.

A market survey in the early years revealed 774 prospective users of forest products worth investigating in the 116 towns and cities within a 40-mile radius of the Forest. By 1935, 132 of these were interviewed. The continued depression caused a postponement of the study until more favorable times and normal markets. These had not arrived before the Forest was hit by the 1938 storm. The small market that did exist at the time, notably for cordwood, was subject to severe competition. Owing to the presence in the market of large quantities of cordwood, resulting from Civilian Conservation Corps activities on state forests, sold at prices at which the private owner could not compete, this outlet was taken from the private owners. In addition, the demand for cordwood lessened with the increasing use of liquid fuels by the local population. At the present time, the situation is such that kerosene and oil are not only preferred because of their convenience, but also because they are cheaper than wood.

All the cuttings prior to 1938 were in the form of thinnings, improvement cuttings, and salvage with the intention to build up the growing stock and improve its quality. From 1930 through 1937, approximately three-quarters of a million board feet were removed. To facilitate marketing, the Forest took membership in

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the regional trade associations, connections which were severed in 1942.

Following September 1938, the operations took on an entirely different aspect. It was estimated at the time that about seven million board feet of timber had been felled by the wind, an estimate which later proved to be quite conservative, and the timber had to be utilized quickly. The New England Timber Salvage Authority was established late in 1938 to take charge of the salvage problem throughout New England. The first emphasis in salvage lay on logging the conifers, and placing the logs in storage reservoirs, where they could await future disposal to mill men, or on dry sites, where they could be sawn up by mills already in operation or being put into operation. Several ponds were leased to NETSA for storage purposes and were filled with pine and hemlock logs before the end of the winter. Dry storage sites were also leased. In the Union Forest three methods of disposal were used. A few million feet were logged and sold to NETSA, chiefly the better grade of conifer logs; a sizeable quantity of lumber was manufactured in the Morse mill by the forest employees; and a large amount of stumpage as well as some logs were sold to independent portable mill operators. By October 1942, close to seven million board feet had been disposed of, an estimate much on the low side, owing to the strict grading and scaling rules applying to logs sold to NETSA. The advent of the Great War made disposition of the logs and lumber an easy matter.

Salvage utilization is still going on. In 1944 about 300,000 board feet, net scale, of hurricane timber, chiefly hardwood, were sold on the stumpage basis, a record which will probably be duplicated in 1945. In all, up to the present time, a volume of close to eight million board feet, net scale, of hurricane timber has been used. The down conifer timber is now badly deteriorated, except that which is still partly rooted; the hardwood timber has lost all its sapwood, but is still sound-hearted. Consequently the gross scale represented by the eight million board feet utilized is probably near nine, if not ten million board feet of pre-hurricane scale. It is estimated that two to three million board feet still remain to be disposed of, though much of it is too scattered for practical logging.

Following 1942, a change of policy was instituted in regard to sawing logs in the Morse mill. The volume of the annual cut, par-

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ticularly that in view following the disposition of the hurricane material, and the necessity to maintain a permanent staff of workers of only two to three men, relatively inexperienced in lumbering, have proven that such practice is less profitable than the selling of stumpage to independent operators. The Morse mill is now closed down; even renting of the mill on a royalty basis to independent operators is not feasible, since it does not yield a sufficient return to cover maintenance costs with a reasonable margin of profit.

WILDLIFE

The use of the Yale Forest for wildlife purposes has always been a primary consideration and, indeed, was specified in the contract between Mr. Myers and Yale University. Under Mr. Myers' ownership, the tract as a whole was handled more or less as a game preserve, the resident manager taking an active interest in the protection of game. This policy has been continued under the management by Yale. The combination of the varied topography, such as lakes, swamps, flatland, and hill land, with the many cover types, such as hardwood, softwood, brush, and open land, make the area ideal for wildlife.

While shooting and hunting are restricted, the trapping of certain kinds of fur-bearing animals by a state-authorized agent, namely, the resident superintendent of the forest, is encouraged. This policy was started in 1933 and has continued up to recent times. The catch of fur-bearing predators during these years includes red and grey fox, mink, muskrat, raccoon, bobcat, skunk, beaver, and even house cats gone native. Sale of the furs contributes to the forest income annually.

Thirty years ago, deer were scarce throughout the region, but now they are plentiful. Under the Connecticut law, there is no public hunting season for deer, but the woodland owners may obtain permits from the State Board of Fisheries and Game to kill deer.

Although beaver are said to be native to the region, none were noticed when Mr. Myers first acquired the property. Since then at least two attempts to restore them by liberating imported stock were made under permit from the State, one about 1906 and again in 1935. In both cases a policy of immediate discouragement had to be adopted, since the resulting damage to timber, both by feeding and by flooding was not compensated for by expected benefits (See

Plate 19). Beaver production has no place in the management of a tract of this kind.

In regard to game birds, grouse are plentiful, as are ducks on Still River at certain seasons, woodcock are present, pheasant are scarce, and there are but very few quail. Still River pond was early set aside as a special wildlife sanctuary and duck food was planted.

The lakes, ponds, and streams are on the whole too shallow or sluggish for game fish and such species as pickerel, horned pout, perch, sunfish, chub, and others dominate. Bushmeadow brook and parts of Bigelow brook are fair trout streams, but the fishing rights are here reserved.

In September 1943, Yale entered into an agreement with the State Board of Fisheries and Game, granting to the State the right to regulate public use for hunting, fishing, and trapping on the Forest. The State governs use by the issuance of regulations and by supplying a reasonable amount of patrol, while Yale is responsible for supplying and posting appropriate notices. In return the Forest has the right to apply for a limited number of hunting licenses, including deer licenses, and has the protection of the State against illicit use.

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DRAINAGE

THE general direction of the major drainage systems of the Union Forest is southerly. Bigelow brook or Bigelow River, one of two outlets of Lake Mashapaug, which lies a mile or two north of the forest close to the Connecticut-Massachusetts boundary, flows southward, roughly bisecting the Forest and with its feeding streams draining most of the forest area. Still River, also flowing to the south, drains the most easterly portion, and branches of Mount Hope River the most westerly. All these rivers eventually reach the Thames River or one of its branches and thus to Long Island Sound.

Shortly after Bigelow brook enters the northern edge of the Forest it forms Bigelow or Myers' pond, an artificial lake whose history goes back to the time of early water-power mills. Near the southern end of the pond it is joined by Gulf brook entering from the northwest and by Bushmeadow brook from the west, both

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junctions being on Myers' preserve. Bass brook, also coming in from the west, joins Bigelow still further south (Compartment 70). Another main creek, running into Bigelow brook, is Branch brook, which flows out of Morse Mill pond near the site of the summer camp, flowing almost due south until it enters Bigelow.

A number of ponds add to the attractiveness and utility of the Forest. Some of them are natural ponds; others are artificial ponds of long standing, dammed in the days of water-power mills, some dating back to early Colonial days; and still others are of more recent origin, established for the purposes of recreation, fishing, and wildlife. Including Myers' preserve, eleven pond areas can be named (5). Bigelow pond in the north central part of the Forest, extending halfway through Myers' preserve, is a long, shallow pond covering about 60 acres and formed by a dam on Bigelow brook. The dam-site area was for a long time a favorite spot for locating water-power mills. Several are known to have been constructed there. Lawson pond, a small artificial pond on Bushmeadow brook about two acres in size, lies just west of the southern tip of Bigelow pond. Kinney pond, containing 5.3 acres in Compartments 14 and 15, is the most attractive lake on the Forest. Gardiner pond, or Old Mill pond as it is sometimes called, is located in Compartment 1 directly west of the old road to Union. Barlow pond lies in the center of the Forest on Bigelow brook at the junction of Compartments 100, 101 and 69 and covers about three acres. It is a small artificial pond on which was located the old Barlow Mill, removed within the last few years. Morse Meadow pond covers 37 acres in Compartment 43 and is a shallow lake with no definable inlet. Its main outlet leads down to Morse reservoir and Morse Mill pond in Compartments 52 and 56 near the location of the Forest School camp. All three ponds are artificial, being built to furnish water for early mills. After the 1938 hurricane they served as storage areas for hurricane timber. The reservoir is 16.5 acres in area, and the Mill pond is about one acre. Lost pond, only partly in the Forest (Compartment 44) is said to have originally been a natural pond, but the water level has been raised by the construction of a small dam. It covers eight acres. Still River pond, a new artificial pond, is a shallow, long area of fifty acres in Compartments 166 and 167. A small pond of two acres, known as Paine pond is an attractive place at the southern end of the Forest in Compartment 118. Two

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large ponds, Crystal pond to the southeast and Chaffee pond to the southwest, do not lie directly in the Forest, but are close enough to be significant. They are by far the largest ponds in the neighborhood.

TOPOGRAPHY

The Union Forest is characterized by a variable topography, somewhat rugged, but still not mountainous in any sense. The lowest elevation at a point where Bigelow brook leaves the Forest is 550 feet and where Still River leaves about 650 feet. The highest elevations are on Coye hill and Walker mountain, both about 1,050 feet. Lead Mine hill directly to the west of the Forest reaches to about 1,150 feet and the highest hill in the area, Bald hill just northwest of Lead Mine hill is 1,286 feet in elevation. It is also the highest point in eastern Connecticut. The maximum difference on the Forest itself is therefore only 500 feet.

Coye hill and Walker mountain are both on the main ridge running through the center of the Forest at an angle of about 20 degrees west of south in the northern half and slightly east of south in the southern half of the Forest. The east boundary of the Forest lies on a spur from the main ridge except where the Forest extends into Still River bottom. The west boundary lies against the main ridge on which the village of Union lies. The north boundary of the Forest coincides with Bigelow hollow, passing over maximum elevations of 900 feet on the east side of Bigelow brook and reaching to 1,020 feet near Union.

On the whole, the ridges are broad and comparatively flat-topped with frequent rock outcrops both on the slopes and summit. The valley bottoms tend to be narrow and in many places originally were swampy. A number of the swamp areas have, however, been converted into ponds.

CLIMATE

Climatic records are kept on the Forest, but as yet the accumulation has not covered a sufficient span of years to make a recording of these data more valuable than those which have been gathered over a long term of years at Mansfield, Connecticut (10), which lies only ten miles to the southwest. The temperatures of the Union Forest are probably slightly lower, the rainfall and snowfall slightly

TABLE 2. WEATHER SUMMARY FROM RECORDS TAKEN AT MANSFIELD (STORRS), CONN.

Item	Years	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Av. temperature (degrees F)	47	26.0	25.2	34.4	45.4	56.5	64.7	69.4	67.6	61.3	50.7	39.7	28.9	47.5
Av. max. temperature (degrees F)	41	34.4	34.9	43.8	55.8	67.9	74.7	79.8	77.4	71.5	61.6	48.4	36.9	57.3
Highest temperature (degrees F)	47	68	65	80	87	92	95	101	96	93	89	74	72	101
Av. min. temperature (degrees F)	41	17.2	16.4	25.5	35.1	45.2	54.0	59.7	57.7	50.9	41.3	30.8	20.7	37.9
Lowest temperature (degrees F)	47	-15	-20	-7	13	25	35	32	39	25	16	5	-17	-20
Average precipitation (inches)	47	3.54	3.38	3.97	3.47	3.42	3.03	4.18	3.97	3.82	3.51	3.39	3.57	43.25
Greatest precipitation (inches)	47	8.52	7.31	7.29	9.51	7.12	9.24	12.24	8.61	9.75	6.74	7.53	9.55	60.18
Least precipitation (inches)	47	1.05	.37	.15	.70	.33	.29	.84	.93	.45	.15	.47	1.11	31.74
Greatest precipitation in 24 hours (inches)	42	2.42	2.90	2.83	3.08	2.88	4.26	4.50	3.05	3.70	3.89	4.50	3.88	4.50
Av. number of days, with rainfall over .01 inches	45	10	8	10	9	9	9	9	8	8	7	7	9	103
Av. snowfall (inches)	30	11.6	13.4	6.5	1.8						0.1	2.2	7.7	43.3
Greatest snowfall (inches)	30	40.0	35.6	18.0	7.0						4.5	13.0	21.5	88.1
Prevailing wind	32	NW	NW	NW	NW	NW	NW	SW	NW	NW	NW	NW	NW	NW

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heavier and the growing season a few days shorter than at Storrs. Table 2 shows average annual temperature to be 47.5°F. , with monthly averages ranging from a low of 25.2°F. in February to a high of 74.7°F. in June. The highest temperature recorded in 47 years was 101°F. and the lowest -20°F. Average precipitation is 43.25 inches with a fairly even distribution throughout the months of the year, but with a slight tendency to increase during July and August. The largest annual precipitation recorded is 60.18 inches and the least 31.74 inches. Snowfall averages 43.3 inches a year, but has reached a maximum of 88.1 inches. Average date of the last killing frost in spring at Storrs is given as May 2 and that of the first killing frost in the fall as Oct. 9, making a growing season of 160 days.

SOILS

In his studies of Connecticut land types (17), Morgan shows by means of reconnaissance land type maps the occurrence of the specific soil series and the land use for which each area is most appropriate. Three of his maps apply in part to the four towns in which the Forest lies and show that seven soil series are found in the Forest. Two soil series are dominant, namely, Gloucester and Brookfield. The Gloucester soils extend eastward with minor interruptions from Bigelow brook in Eastford, but in Union cross over Bigelow to the west with a boundary running roughly 20° west of north. To the west of the Gloucester soil, Brookfield dominates. Morgan's soil key permits the following almost verbatim description of each soil series. Gloucester soils are found on lands of hilly to mountainous topography, having irregular slopes of 8 to 50 per cent or more with occasional to frequent bedrock outcrops. The surface soil is medium to dark brown, mellow with few to many boulders. The subsoil is medium light yellow-brown and friable. The substratum starts at 28 to 36 inches, and is gray to brownish gray, moderately loose and containing a little clay. It has much stone and irregular rock fragments of all sizes, composed chiefly of light-colored granite gneiss and schist. Bedrock lies at 3 to 20 feet. Of the several phases under this series, Gloucester fine sandy loam, stony phase, is most prevalent, grading into rough stony land in the worst places and occasionally in the best into Gloucester fine sandy loam.

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The Brookfield series is found under the same topographic conditions as the Gloucester, but has a surface soil which is medium brown, often with slight reddish cast, mellow, and few to many schistose rock fragments. Its subsoil is bright yellow-brown to reddish yellow-brown, and is friable to firm. The substratum lies at 28 to 36 inches and is light yellowish-brown: it is loose to firm, and is composed chiefly of partially weathered fragments of rust-colored mica schist. Bedrock starts at 3 to 15 feet. The stony phase of Brookfield fine sandy loam is most common, again grading into rough stony land in the worst places and into fine sandy loam in the best.

Hinckley series is the third most common type and is characterized by its sandy, character. The region north and northwest of Lake Mashapaug, the Bigelow valley from the southern third of Union on the south, parts of Branch brook bottoms and other small areas are occupied by this soil. It is defined as a valley soil developed from water-laid material of prehistoric origin, having good surface drainage and unimpeded underdrainage. Topography is irregular with rounded knolls and short ridges and variable slopes of 3 to 15 per cent. It has no bedrock outcrops, no large boulders but well-rounded cobbles, and is more or less gravelly. The surface soil is medium to light brown, mellow to friable, and moderately to excessively gravelly or sandy. The subsoil is yellow-brown, becoming paler in color with depth, and firm. The substratum lies below 28 to 30 inches and is brownish-gray to yellowish-gray, very gravelly or sandy, and composed of water-deposited gneiss or schist material. Merrimac sands also are present but on too small an area to warrant description.

Charlton soils can be listed as fourth most common, although mucks are probably just as frequently found. Both are, however, relatively isolated and cover but small areas. Charlton soil occurs on areas where there is good surface drainage and slightly impeded underdrainage on topography which is hilly with moderate irregular slopes of 5 to 30 per cent. Bedrock outcrops are few to none. The surface soil is medium to dark grayish-brown, friable to firm, with few to many fragments and boulders of schist. The subsoil is light yellow-brown, with slight olive cast with increasing depth and is firm to slightly compact. The substratum lies below 24 to 28 inches and is yellow-olive to drab, very compact, and slightly

porose. It is composed chiefly of a heavy well-decomposed mass of glacial till with schist material predominant and extends with little change to bedrock at 25 to 75 feet.

Muck is an organic soil, of which the largest body lies in the Still River bottom with smaller areas locally in other drainages. Water table is at or near the surface at all times. The organic material is very dark brown to black, mellow and well disintegrated, and often more or less mixed with earthy material of alluvial deposition. It is composed of residues from woody and herbaceous plants, rushes and sedges. Depth to a mineral substratum of light bluish-gray, silty sand occurs from 3 feet on down.

THE HURRICANE OF SEPTEMBER 1938.

Frequent mention is made throughout this bulletin of the great hurricane of September 21, 1938. It was an unusual catastrophe and has had such a profound effect on the management of the Union Forest that the incident merits special description. Kirk (10) summarizes the sequence of meteorological events in an effective manner and includes in addition an account of past atmospheric phenomena which makes it appear that hurricanes are by no means infrequent visitors. It appears that a storm of almost equal proportions and similar nature occurred on September 23, 1815, coming up from the tropics and causing widespread destruction from the Connecticut River to the coast. Other storms of lesser violence occurred in 1788, 1821, 1839, 1869, 1878, 1893, 1898, 1903, 1904, and 1944. The storm of 1938 was particularly destructive, since not only were the winds of high velocity, but the immediately preceding rainfall was so heavy that the ground was thoroughly soaked and thereby the damage greatly accentuated. Kirk states "In September, 1938, moderately heavy rains fell on the 13th and 15th; then during the 5-day period from the 17th to the 21st, inclusive, rain fell almost continually, and during much of the time at excessive rates. Several stations reported 24-hour falls of over 6 inches. The rainfall for this 5-day period was greatest in the middle sections of the State, and the greatest amount at any station was 17.7 inches at Camp Buck (Civilian Conservation Corps) in the town of Portland. More than 13 inches fell throughout a belt 10 to 15 miles wide, extending from Branford, northeastward beyond the Massachusetts border, and the total fall was over 8 inches

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in all sections of the State, except the southeast corner. All streams in the northeastern, middle, and western portions of the State rose to unusually high stages, the Connecticut river rising to 35.4 feet at Hartford, which is only 2.2 feet below the crest of March, 1936." On the Union Forest about 13 to 14 inches fell during this 5-day period. Meanwhile the hurricane formed in the tropics, and moved northward remaining relatively unobserved, since it crossed no land until it hit Long Island and Connecticut. Its forward movement over Connecticut was at a rate of 50 to 60 miles an hour and it consisted of a whirling circular storm more than 300 miles in diameter. "In all such storms wind movement is greater on the right side of the center; but because this storm traveled northward at such an unusually high speed the winds east of its center were exceptionally strong and destructive." Heavy winds, unofficially registering at 100 miles an hour maximum, combined with the extremely soggy condition of the ground and the temporarily high water table caused a destruction to the forests unprecedented in known history, even greater than that of the storm of September 1815.

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TYPE DESCRIPTIONS

TOPOGRAPHIC variation and geographic location favor an interesting complexity of forest types on the Union Forest. Being located in the highest portions of the eastern highlands of Connecticut, the Forest represents a transition zone between the predominantly oak forests of southern Connecticut, and the pine and hemlock types and the northern hardwood types of more northerly regions. The variety of tree species in Table 3 is indicative of this situation.

The forest type map is less indicative, since on it the many hardwood types have been combined into one hardwood category. This was done deliberately, owing to the extreme complexity of the hardwood composition pattern as well as to the existence of a detailed descriptive survey made in 1941, which portrays minutely the character of each variation within each compartment and summarizes the general conditions for the tract in its entirety. This survey, described in a summary report of 75 pages (9), supplemented

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TABLE 3. LIST OF COMMONLY FOUND TREES ON THE YALE FOREST IN TOLLAND AND WINDHAM COUNTIES.

<i>Common Name</i>	<i>Scientific name*</i>
Ash, white	<i>Fraxinus nigra</i> Marsh.
Ash, black	<i>F. americana</i> L.
Aspen, large-toothed or bigtooth	<i>Populus grandidentata</i> Michx.
Basswood, or American linden	<i>Tilia americana</i> L.
Beech, American	<i>Fagus grandifolia</i> Ehrh.
Beech, blue or American hornbeam	<i>Carpinus caroliniana</i> Marsh.
Birch, black	<i>Betula lenta</i> L.
Birch, gray	<i>B. populifolia</i> Marsh.
Birch, paper	<i>B. papyrifera</i> Marsh.
Birch, yellow	<i>B. lutea</i> Michx.
Butternut	<i>Juglans cinerea</i> L.
Cherry, black or sweet	<i>Prunus serotina</i> Ehrh.
Cherry, pin	<i>P. pensylvanica</i> L.
Chestnut, American	<i>Castanea dentata</i> (Marsh.) Borkh.
Dogwood, flowering	<i>Cornus florida</i> L.
Elm, American	<i>Ulmus americana</i> L.
Elm, slippery	<i>U. fulva</i> L.
Fir, balsam	<i>Abies balsamea</i> Mill.
Hemlock, Canada or eastern	<i>Tsuga canadensis</i> (L.) Carr.
Hickory, bitternut	<i>Carya cordiformis</i> K. Koch
Hickory, mockernut	<i>C. tomentosa</i> (Lam.) Nutt.
Hickory, pignut	<i>C. glabra</i> Sweet.
Hickory, shagbark	<i>C. ovata</i> K. Koch
Hophornbeam or Ironwood	<i>Ostrya virginiana</i> (Mill.) K. Koch
Maple, sugar or hard	<i>Acer saccharum</i> Marsh.
Maple, red	<i>A. rubrum</i> L.
Oak, black	<i>Quercus velutina</i> LaMarck
Oak, red	<i>Q. borealis</i> var. <i>maxima</i> (Marsh.) Ashe
Oak, scarlet	<i>Q. coccinea</i> Muench.
Oak, chestnut	<i>Q. montana</i> Willd.
Oak, white	<i>Q. alba</i> L.
Pine, eastern white or northern white	<i>Pinus strobus</i> L.
Pine, pitch	<i>P. rigida</i> Mill.
Pine, red or Norway	<i>P. resinosa</i> Ait.
Red cedar	<i>Juniperus virginiana</i> L. var. <i>crebra</i> Fern.
Tulip tree	<i>Liriodendron tulipifera</i> L.

*Scientific nomenclature conforms to *Standardized Plant Names*. 2d ed. Harlan P. Kelsey, and William A. Dayton. 1942.

by almost 400 manuscript pages of compartment notes, is utilized in the following description of forest types and type variations.

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The types represented on the map are listed below in descending order of total area covered:

Hardwood	5,530.24 acres
Hemlock-Hardwood	812.65 acres
Swamp, open and forested	583.87 acres
Pine-Hardwood	381.25 acres
Open (old field, agricultural and administrative)	224.30 acres
Pure white pine	137.30 acres
Ponds and streams	136.75 acres
Red pine plantations	51.20 acres
<hr/>	
Total	7,857.56 acres

Within each of the forest types, 20-year-age classes and also an uneven-aged class are recognized. The following type descriptions are based largely upon Hess' study (9).

Hardwood type

The hardwood type is a complex one, composed of many species, yet certain distinctive features can be recognized. The Forest is dominantly an oak forest and promises to become more so because of the great damage caused by the hurricane. In general there is a strong difference in composition between the type as found in the northern part of the Forest and that in the southern part. In the northern part the most typical stand is a mixture of red oak, maple, and birch, paper birch being quite common. (See Plates 1 and 6.) It occurs most commonly on intermediate slopes and grades off into a red oak—white oak mixture at higher elevations (see Plate 3) and into a red oak—maple mixture at the lower and moister elevations. Other associated species are gray birch, particularly in the young stands, yellow birch, aspen, hemlock, and white pine. Even an occasional ash can be found.

In the southern part of the Forest, the typical stand is dominantly red oak and occupies all sites except the driest and the wettest. (See Plate 2.) On the drier sites a mixture of white oak, black oak, and hickory with some chestnut oak, scarlet oak, and pitch pine is found. (See Plate 3.) On the wetter sites, one sees a mixture of red oak and maple, with maple becoming more prominent with increasing wetness. Ash is here fairly common in the red oak type and other species such as gray, black, and yellow birch are usually present.

The quality of the trees in the hardwood type is on the whole unsatisfactory and as with quantity is related to site, being the best on good sites.

Pine-hardwood type

Before the hurricane the pine-hardwood type was one of the most promising in the Forest as far as actual and potential timber production was concerned, although the area covered was not as great as that of the hardwood types. The hurricane caused extraordinarily heavy damage throughout the type and leveled almost all of the large pine. Many of the areas will not revert to type but will remain permanently in the hardwood type and have been so mapped. In other areas, where there is a substantial understocking of young pine in the stand, intensive cleaning will allow the pine-hardwood type to reestablish itself. (See Plates 5 and 9.) Without the cleaning it will turn to hardwood type and the young pine will be largely eliminated. As it now stands the type is quite variable in character, the white pine occurring in greatly varying percentages and growing with a large number of associated species, apparently larger than in any other forest type.

The total area now occupied by the type will diminish, if cleanings are not made in the younger age classes where hardwoods are overtopping the pine.

Hemlock-hardwood type

This important timber type is found on intermediate slopes, moist lower slopes and flats, and even in decidedly wet swales in the northern part of the Forest. On favorable sites it occurs also on the upper slopes and ridges. It appears that hemlock could occupy to advantage a much greater area than it now does. Composition of this type may range from pure hemlock, found frequently in small areas of insufficient size to be mapped separately, to stands predominantly hemlock with a mixture of hardwoods, principally red oak, black birch, and maple but also paper birch, white oak, white ash, and yellow birch, and further to stands predominantly hardwoods of the species just named with single trees or small patches of hemlock scattered throughout.

Hurricane destruction was heavy in this type and consequently the remaining stand of merchantable timber runs small in size, but is in an active growing stage. The type on the whole is now much

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more irregular than before the hurricane, contains a great number of leaning trees, and commonly patches of total windfall, originating in a pure hemlock stand and extending out into surrounding hardwoods. The age designation on much of this type has therefore been changed from even-aged to uneven-aged.

Swamp type

The topography, influenced in a marked degree by glacial deposits, has led to the formation of frequent swamps, ranging in size from less than an acre to over 20 acres. These swamps are either open or covered with hardwoods. Conifer swamps are lacking. On the whole the type is of small economic importance, owing in part to small size of the trees, their roughness, sparse stocking, and in part to the undesirable character of the species, such as alder and red maple, or to the lack of any forest stand whatever. Most of the forested swamps are stocked principally with red maple, with varying amounts of yellow birch, white ash, black ash, butternut, and slippery and American elms. Alder swamps are frequent but must be considered a brush type rather than a forest type. The better hardwood swamps, such as occur in the northern half of the Forest, may have a mixture of red maple and yellow birch, with some white ash, black ash, and even hemlock present in addition to the featured species. Tulip tree is occasionally found. In one area, the northern Still River swamp, the forest cover has been killed within the last ten years, owing to a rise in water level. (See Plate 19.)

Pine type

The pine type includes relatively pure stands of white pine, not only naturally reproduced largely of old-field origin, but also plantations. (See Plates 8, 10, 11, and 12.) The old-field stands were formerly of considerable economic importance, but owing to the action of the hurricane have now been relegated to a subordinate position. The only remaining stands of the former 81- to 100-year-age class occur on sheltered west slopes of Coye hill, Walker mountain and Horse Pound hill, much of it off the Forest proper and in Myers' preserve. Heavy damage occurred even in the older plantations.

Open type

Under this heading have been classified administrative areas,

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agricultural lands, and abandoned fields which have at the most only a sparse covering of scattered tree growth. These tracts are scattered throughout the Forest, chiefly along or near the major roads. Old fields which have come up into solid timber stands are classified in the appropriate forest type.

Red pine type

This type consists altogether of plantations, since no native red pine is present in the Forest. (See Plate 14.) The stands range from 10 to 35 years in age and consequently were not seriously affected by the hurricane.

• FOREST SUBDIVISIONS

The Forest has been divided into compartments for purposes of management, as indicated on the type map. The compartments number 165 and range in size from a minimum of 0.75 acres (Compartment 25) to a maximum of 236 acres (Compartment 72). The smaller sized compartments are usually located along the borders of the property where future acquisition may increase their size to conform more closely to the average size, namely, close to fifty acres. Sixteen compartments are less than twenty acres in size and 13 compartments more than one hundred acres. The boundaries of the compartments in most instances coincide with waterways, roads and trails, and property bounds. Their location on the ground is simplified thereby, particularly since the compartment numbers have been painted on trees at the corners along all the roads and trails.

Type and volume statistics are available for each compartment, but have not been included in this report.

TYPE AREAS AND VOLUMES

The forest survey of 1937 furnished a base type map, which however was no longer strictly applicable after the 1938 hurricane. The descriptive survey of 1941 resulted in sufficient information to correct the 1937 map and bring it up to date for post-hurricane conditions. This revised map was later used in 1944, as the basis for the volume survey made at that time and again further modified. The present distribution of types is shown in the colored map accompanying this bulletin.

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Table 4 summarizes the type conditions for the forest and Table 5 the summarized volumes. The ages of forest stands are here divided into 20-year classes with the following designations:

1 to 20 years	age class 1
21 to 40 years	age class 2
41 to 60 years	age class 3
61 to 80 years	age class 4
81 years and over	age class 5

The plus sign following the age designations of the first two classes on the map indicates that trees of older age, or standards, are found scattered throughout, but have a volume insufficient to throw the stand into a higher age group. Almost six per cent of the total area is classified as open, water, or unforested swamp; 70.4 per cent as belonging to the hardwood class; 17.6 per cent in the various conifer combinations; and the remaining 6.1 per cent as hardwood swamp. Although only 39.3 per cent of the total forested acreage is listed as being in the first two age classes, the actual appearance of the Forest would tend to belie this statistic. This results from the fact that, while the stands of older age and those classified as uneven-aged have been badly hit by the wind and have suffered a tremendous reduction in growing stock, they have sufficient material of the age class in question to cause a temporary allocation to the class. As the new stands develop there may be a reallocation to younger age classes, when the latter form the dominating component. The percentage of the forested area in conifer type is small for somewhat the same reason. Mature conifers in all types were severely damaged, frequently requiring at least a temporary assignment to pure hardwood type. The general prevalence of young pine and hemlock in the understory in many portions of the Forest leads one to believe that with moderate silvicultural manipulation the composition on substantial areas can be so modified as to appreciably increase in the future the area occupied by the various conifer types.

The total volume in the Forest, according to Table 5, is 10,125,400 board feet plus 43,855 cords. The minimum diameter for board measure is taken at ten inches for hardwood and six inches for pine; that of cord volume is four inches. Cord volume has been computed for hardwood only, and includes small trees, trees above ten inches

TABLE 4. DISTRIBUTION OF AREA BY COVER TYPES

Cover type	Area in acres by age class:					
	1 and 1+	2 and 2+	3	4	5	Total
Hardwood	805.30	1,345.20	1,607.01	216.80		5,530.24
Hemlock-hardwood	34.35	51.25	198.65	63.35	.90	812.65
Pine-hardwood	189.20	106.80	46.75	3.15		381.25
White pine	27.45	71.65	33.75	4.45		137.30
Red pine	47.10	4.10				51.20
Swamp-hardwood	107.45	115.20	193.05	8.10		482.30
Total forested area	1,210.85	1,694.20	2,079.21	295.85	.90	7,394.94
Agriculture						58.75
Pasture (Old field)						165.55
Ponds and streams						136.75
Open swamp						101.57
Total open land						462.62
Total area of the forest						7,857.56

TABLE 5. VOLUME BY FOREST TYPES, AGE CLASSES, AND SPECIES GROUPS

Forest type	Species*	1 and 1 +		2 and 2 +		3		4		5		Uneven		Total	
		Cords	Board feet	Cords	Board feet	Cords	Board feet	Cords	Board feet	Cords	Board feet	Cords	Board feet	Cords	Board feet
Hardwood	O	459	64,900	4,548	363,825	6,846	1,021,775	1,127	429,725			4,605	1,258,625	17,665	3,138,850
	OH	627	43,125	5,153	159,100	5,183	353,225	1,183	190,725			5,033	601,750	17,819	1,347,925
	H		30,200		107,100		292,850		124,025				403,975		958,150
	P		40,975		123,000		166,525		174,450				170,475		518,425
	Total	1,086	179,200	9,701	753,023	12,659	1,834,375	2,310	761,925			9,728	2,434,825	35,484	5,963,350
Hemlock-hardwood	O	13		150	2,475	465	94,525	171	54,850		675	956	292,950	1,759	445,475
	OH	9		106	375	804	90,800	339	50,375		900	1,471	241,800	1,759	384,250
	H		600		13,900		457,575		252,950		8		883,300		1,617,725
	P				6,875		73,875		24,525				118,950		224,225
	Total	22	600	256	23,625	1,269	716,775	510	382,700	12	10,975	2,427	1,537,000	4,496	2,671,675
Pine-hardwood	O	50	14,500	65	1,375	59	15,575	2	50			50	5,300	226	37,000
	OH	35	675	171	3,500	159	32,800	1	100			44	6,525	410	43,500
	H		375		11,300		14,525		100				15,950		42,250
	P		33,975		82,875		271,175		13,050				48,500		449,375
	Total	85	49,525	236	99,250	218	334,075	3	13,200			94	76,275	636	572,325
Pine	O			18		8	2,450							26	2,450
	OH			48		28	850	7						84	2,050
	H				350		2,875		4,275						7,400
	P		1,525	66	248,025	36	255,050	7	46,650						546,975
	Total	1	1,525		249,475		261,225							110	558,875
Red pine plantation	O	2												2	
	OH	3		11										14	
	H														
	P		7,450		12,425		7,925								
	Total	5	7,450	11	12,425		7,925							16	10,875
Swamp hardwood	O			8	2,625	49	111,825	1	23,375						
	OH			645	23,750	1,780	35,750	106	2,050			10	2,175	71	13,800
	H				1,700		31,050		26,475			415	6,350	3,042	239,600
	P				7,950		186,550								45,850
	Total	99	8,475	653	36,025	1,829	186,550	107	26,475			425	81,795	3,113	40,050
Grand total		1,208	246,775	10,021	1,171,825	16,011	3,333,000	2,017	1,230,050	12	10,975	12,674	4,120,875	43,855	10,125,400

* O = Oak
OH = Other hardwoods
H = Hemlock
P = Pine

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in diameter with a merchantable length of less than one-half a log, and the tops of merchantable trees. The volumes of hardwoods have been estimated by tables contained in Yale School of Forestry Bulletin 54 (16) and have been based on a tally of trees by diameter and log height. The scale is by the International rule for $\frac{1}{4}$ -inch kerf. Volumes for pine have been estimated from one of Frothingham's tables (6) and for hemlock from Merrill and Hawley's table (14). Of the total board-foot volume, the distribution by species groups is as follows:

Oak	3,637,575 board feet
Other hardwoods	2,107,325 board feet
Hemlock	2,671,375 board feet
Pine	1,799,125 board feet

It is apparent that the oak, pine, and hemlock dominate in volume, a fortunate circumstance since on the whole they are the fastest growing and most valuable of all the species.

Table 6 shows that 11.9 per cent of the board measure is in the 6- to 9-inch diameter class, this volume being all conifer, 85.8 per cent in the 10- to 17-inch sizes and only the very small remaining volume of 2.3 per cent in sizes 18 inches and larger.

Reconnaissance estimates on the Forest in 1929, when the transfer to Yale took place, list the standing volume at about 25,000,000 board feet, which however appeared to represent an overestimate of about 23 per cent, if credence is placed on a check cruise of about 1,500 areas made in 1930. Cutting in pre-hurricane years amounted to a little less than one million board feet, and was more than replaced by growth, which at the time was estimated at about a half million board feet a year. Adjusting for the overestimate, deducting the cut and adding the sum of annual growth would result in a revised estimate for 1938 of about 23 million board feet. The 1937 survey would have furnished an accurate appraisal, but since it had no meaning or application after the hurricane damage, the computations were not completed. The 1944-5 survey now shows a volume of close to 10 million feet; the scaled volume of utilized hurricane material is close to 8 million feet, which if adjusted to terms of pre-hurricane volume should represent nearly 10 million feet, owing to the high stumps and incomplete utilization of the salvage job, the conservative scaling practice, and the loss of the

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TABLE 6. DISTRIBUTION OF VOLUME BY DIAMETER GROUPS

Species group	Volume in classes of diameter at breast height									
	4 to 9 ins.		6 to 9 ins.		10 to 17 ins.		18 ins. and larger		Tops of merchantable trees	
	Cords	Board feet	Cords	Board feet	Cords	Board feet	Cords	Board feet	Cords	Board feet
Oaks	13,139				1,877	3,569,625	32	67,950	4,702	19,750
Other hardwoods	18,883				2,439	1,984,400		32,925	2,783	24,105
Hemlock		669,450				1,982,575		19,350		
Pine		531,900				1,155,300		111,925		
Total	32,022	1,201,350			4,316	8,691,900	32	232,150	7,485	43,855
										10,125,400

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sapwood through decay in timber which was not logged immediately. The difference between the pre-hurricane estimate of 23 million feet and the 10 million feet of standing timber plus the 9 to 10 million feet gross of salvaged timber, represents unsalvaged remnants of the hurricane-damaged timber scattered throughout the Forest, much of it in concentrations which are too low to be logged and in trees which are now too far deteriorated and too small to be merchantable. Probably not more than a half million board feet of this remaining 3 to 4 million board feet will be salvaged in the future.

Comparisons of volumes in areas in the various forest types and age classes show effectively the low degree of stocking now existing on the Forest and indicate indirectly that a long period of rebuilding and improving the forest capital lies ahead.

GROWTH

A wide basis of information for the estimation of growth is available for the Union Forest, not only because of detailed measurements made in the Forest itself, but also because it was possible to draw upon information which the Connecticut Forestry Department has gathered on its two neighboring state forests, the Nipmuck and the Natchaug. For the purpose of the present calculation, records of diameter and diameter growth, as read from increment borings, and of bark thickness and height of trees were borrowed from the State Department and combined with similar records taken in the Union Forest after a preliminary study showed that such a combination was permissible. Altogether 2,407 such samples were thus made available, covering at least 22 species. Each sample was a tree arbitrarily selected in accordance with cruising specifications as being located nearest the center of the circular plot of the line-plot cruise.

The various species show interesting differences in growth potentiality, as is indicated briefly in Table 7, which classifies the species into groups on the basis of the past ten years' growth in diameter, uncorrected for bark increment.

The dominating species of the forest from the point of view of merchantable volume, namely, red and scarlet oaks, white pine, and hemlock all have average diameter growth rates above 1.5 inches per decade (except white pine over 60 years of age, of which

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TABLE 7. RANKING OF SPECIES BY RATE OF GROWTH

<i>Growth class (inches)</i>	<i>Species</i>	<i>Number of samples</i>	<i>Past 10-years' diameter growth, wood only (inches)</i>
2.00 and over	White pine, 1-20 yrs.	12	3.08
	Aspen	11	2.38
	White pine, 21-40 yrs.	57	2.25
1.80 to 1.99	Black and scarlet oaks	266	1.88
	Red oak	470	1.84
1.60 to 1.79	Black cherry	15	1.63
	White pine 41-60 yrs.	144	1.61
	Tuliptree	12	1.60
1.40 to 1.59	Hemlock	226	1.51
1.20 to 1.39	White and chestnut oaks	353	1.37
	White pine, 61-80 yrs.	18	1.34
	Black and yellow birches	191	1.20
1.00 to 1.19	White ash	91	1.17
	Sugar maple	36	1.15
	Paper birch	47	1.15
	Red maple	293	1.14
	Miscellaneous swamp hdwds.	70	1.12
	Hickory	79	1.02

there is relatively little). The white pine data show a definite decrease in growth rate with advancing age. The plottings of growth rate over diameter reveal some interesting relationships, in that those for most of the hardwood species show no particular trend; in other words, a horizontal line fits the data just about as well, if not better, than a sloping line. Only in the case of red oak, and, to a lesser extent, black and scarlet oaks, do growth rates increase perceptibly with diameter. The plottings of the conifers show a definite increase of growth rate with increasing diameter. Composite trend lines corrected for bark increment, for five groups of species, were used in connection with stand tables for the entire range of type and age classes to arrive at the estimate of board-foot volume growth for the entire tract. These five groups were oaks, other

hardwoods, swamp hardwoods, hemlock, and pine. The adjustment for bark increment varied slightly among the several species, but centered very closely around .08 inch increase for each inch of wood increment in the case of hardwoods and pine and .09 inch for hemlock.

To facilitate various comparisons and to furnish the basis for estimating cutting budgets, the results are here presented in terms of growth percentages, but not without a warning to the reader of the variable nature of these percentages, particularly as applied to board-foot volume. With constant diameter increment, the growth percentage curve falls off sharply from an infinite value at the point where a tree suddenly enters the merchantable class, reaching a comparatively level and low rate only at the larger diameter classes. In other words, the average diameter and the distribution of trees among the diameter classes alone have a decided influence on the percentage rate. Advancing age, correlated with increase in average diameter, also has its effect. Finally the nature of the volume table itself is a factor of importance. For example, the hemlock percentages tend to be higher than those for white pine, owing to the fact that the volume tables used for hemlock assume less complete utilization in the smaller size classes than do those for white pine, but approximately the same utilization in large sizes. Thus an artificial stimulus is introduced with increasing size.

For the species groups, the following growth rates have been computed on the simple interest basis for the next 10-year period: Pine—5.07 per cent, hemlock—7.39 per cent, oaks—5.14 per cent, and other hardwoods—2.86 per cent, contributing to a weighted average of 5.17 per cent for the entire Forest. For the forest types, the following growth rates have been obtained: Hardwood—4.75 per cent, hemlock-hardwood—6.12 per cent, pine-hardwood—4.06 per cent, pine—6.52 per cent, red pine—15.55 per cent, and swamp hardwood—3.61 per cent. These percentages do not include in-growth, which is handled separately. Similar data are available for each age and species group class for each type, but are not listed here.

The average growth rate of 5.17 per cent applied to the present merchantable volume of 10,125,400 board feet, gives an estimate for current growth of 523,483 board feet per year for the next 1 year period, if the stand is left untouched. However it is planned

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to continue cutting operations on a minor scale so as to defray at least part of the expenses of running the Forest. The degree to which cutting can be made and the effect it has on the rehabilitation of the stand can be estimated through the application of the formula given by Meyer (15):

$$V_n = V_o (1 + g)^n - \frac{A}{g} [(1 + g)^n - 1]$$

where V_n is the volume at the end of the period of prediction, V_o the initial volume, g the growth rate on the compound interest basis, and A the annual cut. The simple rate of 5.17 per cent for the 10-year period corresponds to a compound rate of 4.25 per cent, which is the rate used in the following calculation. (See Table 8.)

TABLE 8. GROWING STOCK AT THE END OF 10 YEARS,
FOLLOWING VARIOUS INTENSITIES OF CUT

<i>Annual cut</i>	<i>Volume of present merchantable trees at the end of 10 years (board feet)</i>	<i>Estimated ingrowth (board feet)</i>	<i>Total estimated volume (board feet)</i>
None	15,352,100	2,218,300	17,570,400
100,000	14,137,500	2,218,300	16,355,800
200,000	12,923,000	2,218,300	15,141,300
300,000	11,708,400	2,218,300	13,926,700
400,000	10,493,800	2,218,300	12,712,100
500,000	9,279,200	2,218,300	11,497,500

In Table 8, ingrowth has been estimated as being equal to 30 board feet per acre per year, occurring on the growing area of 7,394.4 acres of forest land. This is a conservative figure, as it involves a substantial factor of safety. With optimum development, ingrowth may probably be 50 per cent larger than estimated in the above.

The cutting should not exceed 200,000 to 300,000 board feet annually and even this will mean a somewhat slow progress away from the low degree of stocking now prevalent. Silvicultural requirements will of course be a factor of first importance in determining the volume of cut. The total volume of cut will be increased to a marked degree, if further utilization of wind-thrown and wind-damaged timber is feasible.

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ILLUSTRATIONS

PLATE I

Red oak stand, 41 to 60 years of age, with a mixture of red maple and paper birch. Located in Compartment 31.

PLATE 2

Red oak stand, 61 to 80 years of age, with an understory of white oak and red maple. Some trees felled by the hurricane still remain, although the larger trees were utilized in 1944, six years after the blowdown. Two to three million feet of scattered damaged timber still remain on the Forest. Located in Compartment 97.

PLATE 3

White oak stand, 41 to 60 years of age, with a sparse mixture of hickory and black oak. Located in Compartment 175.

PLATE 4

Pure white ash stand, 41 to 60 years of age, with a 19-inch black cherry in the foreground. An occasional variation of the general hardwood type. Located in Compartment 3.

PLATE 5

Red maple with mixture of yellow birch, 41 to 60 years of age, covering advance reproduction of white pine. The 31-inch pine in the background is one of the few large trees not felled by the 1938 hurricane. Located on Myers' preserve, just off Compartment 16.

PLATE 6

Paper birch stand, 40 years of age, a not uncommon component in the northern part of the Forest. Located on Myers' preserve on the western slope of Coye hill.

PLATE 7

Sleet damage in hardwood type in 1921. A recurring form of damage, contributing much to the prevailing poor form of Connecticut hardwoods.

PLATE 8

Natural reproduction of white pine, 10 years of age, seeded in on former agricultural land. Located in the northern part of Compartment 52.

- PLATE 9.

Advance white pine reproduction under mixed hardwood stand, 21 to 40 years of age. The hardwoods are gray and paper birches, red maple, aspen, and red oak. Located in Compartment 28.

PLATE 10

Natural white pine stand, 20 years of age, seeded in on former agricultural land. Cleaning operations have removed all competing hardwoods. Located in Compartment 122.

PLATE 11

Pure white pine, 61 to 80 years of age, in Compartment 66. One of the few small stands of mature age undamaged by the hurricane. Located on the western slope of Coyo hill.

PLATE 12

Group of white pine, 61 to 80 years of age, at the edge of Bigelow pond, still standing after the 1938 hurricane, having been protected by lying in the lee, or under the western slope of Coye hill. Located on Myers' preserve.

PLATE 13

Complete destruction of a 40-year-old white pine stand by the 1938 hurricane, followed by salvage cutting. The white pine seedlings have come in since the blowdown. Located in Compartment 175.

PLATE 14

Red pine plantation, 25 years of age, in Compartment 115.

PLATE 15

Pine-hemlock-hardwood mixture, 81 to 100 years of age, a variation of the pine-hardwood type. Red and white oaks and red maple constitute the hardwood components. Located in Compartment 66.

PLATE 16

Uneven-aged hemlock-hardwood type, the hardwoods being chiefly red oak, red maple, and paper birch. Located in Compartment 28 on western slope of Coyo hill.

PLATE 17

Mixed hardwood stand, 21 to 40 years of age, with a heavy understory of hemlock. The hardwoods are red maple, yellow and paper birches, red oak, and ash. Located in Compartment 57.

PLATE 18

Swamp hardwood stand, 40 years of age, composed principally of red maple on a swampy flat beside Bigelow brook. Located in Compartment 66.

PLATE 19

Former swamp hardwood type on Still River further flooded through the activity of beaver in constructing dams and the diking of lowlands by a road crossing. The flooding resulted in the killing of all trees. Located just north of Compartments 160 and 167.

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- 43.—The Tympanis Canker of Red Pine, by John R. Hansbrough. 1936. Price \$1.00.
- 44.—The Influence of Soil Profile Horizons on Root Distribution of White Pine (*Pinus strobus* L.), by Harold J. Lutz, Joseph B. Ely, Jr., and Silas Little, Jr. 1937. Price \$1.00.
- 45.—Disturbance of Forest Soil Resulting from the Uprooting of Trees, by Harold J. Lutz. 1940. Price 50 cents.
- 46.—*Asterolecanium variolosum* Ratzeburg, A Gall-forming Coccid, and Its Effect upon the Host Trees, by Thaddeus Parr. 1940. Price 75 cents.
- 47.—Penetration of the Walls of Wood Cells by the Hyphae of Wood-Destroying Fungi, by Phimister Proctor, Jr. 1941. Price 50 cents.
- 48.—Growing of White Pine on the Yale Forest near Keene, New Hampshire, by Ralph C. Hawley and Robert T. Clapp. 1942. Price 75 cents.
- 49.—Management of Loblolly Pine in the Pine-Hardwood Region in Arkansas and in Louisiana West of the Mississippi River, by Herman H. Chapman. 1942. Price \$1.00.
- 50.—Decay of Western Hemlock in Western Oregon and Washington, by G. H. Englerth. 1942. Price 75 cents.
- 51.—Yield of Even-Aged Stands of Loblolly Pine in Northern Louisiana, by Walter H. Meyer. 1942. Price 40 cents.
- 52.—White Pine Blister Rust in Western North America, by J. L. Mielke. 1943. Price \$1.00.
- 53.—Establishment, Development, and Management of Conifer Plantations in the Eli Whitney Forest, New Haven, Connecticut, by Ralph C. Hawley and Harold J. Lutz. 1943. Price \$1.00.
- 54.—Volume Tables for Connecticut Hardwoods, by Walter H. Meyer and Raymond Kienholz. 1944. Price \$0.50.
- 55.—The Yale Forest in Tolland and Windham Counties, Connecticut, by Walter H. Meyer and Basil A. Plusnin. 1945. Price \$1.00.

THE YALE FOREST

IN
TOLLAND AND WINDHAM COUNTIES,
CONNECTICUT

1945

SCALE: 1 INCH = 1320 FEET

0 1320 2640 3960 1 MI.

LEGEND

TOWN LINE
HARD SURFACED ROADS
GRAVEL ROADS
GRINDLE WOOD ROADS
OTHER ROADS & TRAILS
FOREST BOUNDARIES
COMPARTMENT BOUNDARIES
TYPE & AGE-CLASS BOUNDARIES
COMPARTMENT NUMBERS

COVER TYPES

HARDWOOD
HEMLOCK-HARDWOOD
PINE-HARDWOOD
PINE
RED PINE
SWAMP
OPEN-ADMINISTRATIVE
AGRICULTURAL
OLD FIELD

AGE CLASSES

1-20 YEARS 1
21-40 " 2
41-60 " 3
61-80 " 4
81+ " 5
UNEVEN-AGED U
WITH STANDARDS +