THE FOREST SITUATION IN THE UNITED STATES

A SPECIAL REPORT
TO
THE TIMBER CONSERVATION BOARD

PREPARED BY THE
FOREST SERVICE
UNITED STATES DEPARTMENT OF
AGRICULTURE

JANUARY 30, 1932

TABLE OF CONTENTS

INTRODUCTION

The purpose of this report is to make immediately available to the Timber Conservation Board information dealing with the extent of present forest areas, timber supplies, current and potential timber growth, forest depletion, and timber requirements in the United States, obtained by an investigation initiated by the Forest Service about one and a half years ago. The most recent report embodying similar information in considerable detail is "Timber Depletion, Lumber Prices, Lumber Exports, and Concentration of Timber Ownership," prepared by the Forest Service in 1920 as a result of Senate Resolution 311.

The present report gives the best information on the general forest situation in 1930 that could be compiled from readily available material, pending the time when authentic data will be supplied by intensive investigations now under way or planned by the Forest Service.

Cooperation Received

The work of assembling the data was decentralized as far as practicable, but with the Washington, D. C., office of the Forest Service necessarily compiling much of the information and preparing the report. Forest Service administrative and research units in the field collected most of the information on resources, and assisted in the estimating of timber growth and in the analysis of timber requirements.

The aim was to utilize every available source of information and to check the figures by the judgment of well-informed men in the different regions, hence, both in the assemblage of regional information and its review and approval, fullest cooperation was sought from various agencies and individuals outside the Forest Service. This was especially true in the case of State foresters, superintendents of Indian reservations, and local pathologists and entomologists. In general, cooperation was received from State foresters, forest commissioners, officials of the Bureau of the Census and the Indian Service, extension foresters, consulting foresters, forest engineers, economists, pathologists, entomologists, directors of agricultural experiment stations, deans of colleges of forestry, secretary-managers of lumber, pulp and paper, timber, and fire associations, owners and managers of lumber, pulp and paper, and timber companies, timber cruisers, and other reliable sources of information.

Basis of Data

Existing material is spotty in character. Some of it may prove to be very inaccurate. The disadvantages and the danger of error inherent in the compilation of data from widely different sources must also be recognized.

Thoroughly reliable data on such matters as the remaining stand of timber, its quality, rate of growth, and the extent of depletion, and on the areas of different timber-cover classifications, can be obtained only by a thoroughgoing forest survey. A survey of this character is being made by the Forest Service, but at the rate of progress possible with the present appropriation scale the results for the entire country will not be available for several years.

More has been done in estimating the quantity of saw timber than in any other of the phases mentioned. Even so, some of the timber remaining in the United States has never been cruised by any method, and that cruised has been estimated by different methods and by different men, and also at different periods when widely diverse standards of utilization were in effect. Relatively few of the estimates of national forest timber are based on intensive cruises.

The report prepared by the Forest Service in 1920 in response to Senate Resolution 311 embodied the first attempt to cover for the entire country the total volume of material below saw-timber size in cubic feet. A similar attempt has been made in this report, but with few more sources of data than were available in 1920.

The information on forest areas has been compiled from a great variety of sources, but is at best fragmentary, especially as to the restocking and non-restocking areas.

The estimates of timber growth are based on a few studies of growth made at various times during the past 30 years. Although they represent more detailed data than were ever before available, it is not claimed that they are better than carefully prepared approximations.

Regions Defined

Figure 1 shows diagrammatically the more or less arbitrary State groups which are used in large part for statistical purposes. It shows also the principal forest sections of the United States. Data for Kansas and Nebraska are not available, hence the estimates for the Central region are not complete; these omissions are, however, unimportant.

Terms Used

Various terms found in this report are used with the following meanings:

"Forest areas," except as otherwise stated, embraces only commercial forest land, or land capable of producing commercial timber in commercial quantities. Abandoned farm land where timbered or in some stage of restocking is included in the forest areas. Areas of low-grade woodland and scrub, such as the pinon-juniper stands of the Southwest, scrubby mountain or alpine stands, and chaparral, which are considered permanently "non-commercial forest land," are omitted from forest areas. "Non-commodity forest areas," including land capable of producing commercial timber in commercial quantities but withdrawn from commodity use, as in parks, monuments, and the like, are also omitted from forest areas.

"Old-growth areas" and "old-growth stands" comprise stands which have not been logged, or at most have been lightly culled, and which are ordinarily regarded as virgin forests.

"Second-growth areas" and "second-growth stands" are of comparatively recent origin. They comprise stands which have followed logging, fire, or some other destructive agent, including old-growth stands which have been culled heavily.

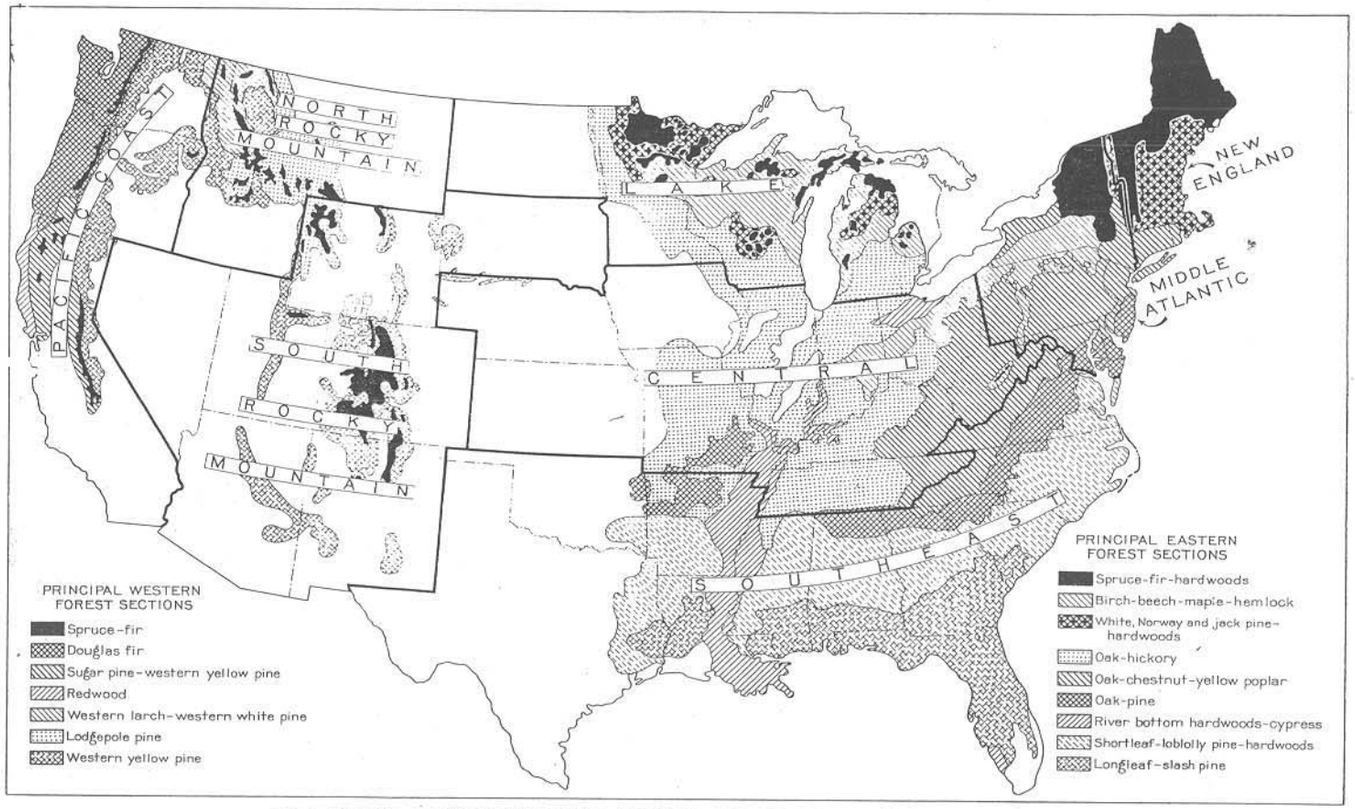

FIG. I.-FOREST REGIONS BY STATE GROUPS AND PRINCIPAL FOREST SECTIONS

"Saw-timber areas" and "saw-timber stands" include stands where a large proportion of the timber is of sufficient size for manufacture into lumber in accordance with the prevailing logging and milling practice of the region.

"Cordwood areas" and "cordwood stands" are stands where the bulk of the timber is less than saw-timber size but large enough for cordwood.

"Saw timber" comprises that portion of the stand on saw-timber areas of sufficient size for manufacture into lumber.

"Cordwood" comprises that portion of the stand on saw-timber areas not of sufficient size or required quality for manufacture into lumber and the entire stand (trees less than 4 to 7 inches in diameter, depending on the cutting practice of the region, not included) on cordwood areas. It may thus include occasional trees of saw-timber size which occur in cordwood stands but not in sufficient quantity to be lumbered.

"Restocking areas" comprises lands that once supported a stand of timber, which is now being renewed; the bulk of the growth is less than cordwood size. "Satisfactory restocking areas" comprises lands 70 per cent or more restocked with commercial species; "fair restocking areas," 40 to 69 per cent restocked; "poor restocking areas," 10 to 39 per cent; and "non-restocking areas," lands where the timber is being renewed very slowly, if at all.

"Timber losses" includes only "abnormal timber losses," or losses resulting from forest fires and such losses from disease, insects, drought, wind, etc., as are of an epidemic or cataclysmic order. The annual fire losses are based on a 5 year period, or an average of the years 1925 to 1929, inclusive; the annual abnormal disease, insect, drought, and wind losses are based on a 10 year period, or an average of the years 1920 to 1929, inclusive. "Normal timber losses," including such as are constantly occurring as a result of disease, insects, wind, etc., are taken into account only in the estimate of timber growth.

"Timber cut" comprises the timber cut annually on the forest areas. The total quantity in cubic feet includes the material destroyed in the process of logging, as well as that cut and utilized. The relatively small quantities of fuelwood, poles, and posts cut on the noncommercial forest areas are not included in the timber cut. The annual timber cut is based on a 5 year period, or an average of the years 1925 to 1929, inclusive.

"Timber growth" comprises only net growth, or the difference between gross growth and normal timber losses. Hence estimates of present and future growth are for net increment, after allowing for normal losses from decay, insects, etc. No allowance has been made for abnormal or unusual losses from disease or insect epidemics, fires, hurricanes, etc., for these are taken care of in the estimates of drain on the forest; but the effect of these destructive agents in changing the character of the timber cover, slowing up or accelerating the rate of growth, etc., have been taken into consideration.

As in the estimate of stand and drain, the growth figures represent volume of wood without bark. The board-foot volumes are on the basis of estimated mill tally,

assuming reasonably complete utilization. The growth in cubic feet on saw-timber and cordwood areas is for stem wood (together with the large limbs in the case of hardwoods), including all trees 4 inches or more in diameter at breast height.

Units of Measure and Converting Factors

Board-foot estimates of saw timber are given in terms of lumber tally rather than log scale. Cord estimates are given in terms of peeled wood, with a cord comprising 90 cubic feet. Board feet of lumber are conveted to cubic feet of standing timber and vice versa, on the basis of factors ranging from 160 cubic feet in certain softwoods to 250 cubic feet in certain hardwoods, per 1,000 board feet for saw timber.

EXTENT OF FOREST RESOURCES

For many years the United States has been the largest consumer of wood in the world. We now use nearly half the lumber, more than half the paper, and about a third of the naval stores produced in the world. On the other hand, the wood to supply these and numerous other requirements has been mined from our forests much as coal has been mined from the ground. And, except for increasing protection from fire, destructive exploitation of the forest still continues. Such restoration of the forest as has occurred, with very rare exceptions, has been a matter of accident rather than design.

Original Forest

The original forest embraced more than 800,000,000 acres, or nearly half the land area of the United States. In the East, a magnificent stand of old-growth timber, wonderfully rich in variety of species and quality of material, stretched in an almost unbroken expanse from the Atlantic Ocean to the prairies. Pines and other soft-woods predominated in the north and along the Atlantic and Gulf coasts, while in the Appalachians and on the fertile soils of the Central States and the lower Mississippi Valley, oak, hickory, ash, chestnut, yellow poplar, and other valuable hardwoods abounded. In the West, also, practically all of the land not too arid to support tree growth was covered with a forest of virgin timber, interspersed with occasional patches of younger, even-aged stands, as of Douglas fir and western white pine, following fire. Along the Pacific Coast the marvelous stands of Douglas fir, western hemlock, true firs, western red cedar, Sitka spruce, western yellow pine, sugar pine, and redwood formed one of the finest softwood forests in the world.

Present Forest Area

Of the original forest area there now remains about 60 per cent, or approximately 506,000,000 acres, excluding in both cases about 100,000,000 acres of non-commercial forest or low-grade woodland and scrub. The present commercial forest area aggregates 496,000,000 acres. (Table 1 and Fig. 2.) The reduction in the original forest area has naturally been the heaviest in the most fertile and most densely populated sections of the country. Thus in the Central and Middle Atlantic regions the forest areas have been reduced to nearly two-fifths of their former extent, while in the North Rocky Mountain and South Rocky Mountain regions the reduction has been comparatively slight. (Fig. 1.) The present forest area of New England comprises about 70 per cent of the original forest area, of the Lake region about 50 per cent, of the Southeast about 65 per cent, and of the Pacific Coast region about 90 per cent.

By far the largest single factor in reducing the forest area, obviously, has been the clearing of land for agriculture. With the development of the lumber and other wood-using industries, logging preceded land clearing, but in the early days the great bulk of the timber cut in clearing 150,000,000 acres was destroyed because there was no market.

More than 10,000,000 acres of commercial forest land, or land suitable for the production of commercial timber in commercial qualities, has been withdrawn from commodity use, as in parks, monuments, reservations, preserves, and the like. The

Table 1 - Present forest area of the United States, by character of growth and region

Region	Total		Saw-timber areas			Cordwood areas	Fair to satisfactory restocking areas	Poor to non-re stocking areas
			Total	Old growth	Second growth			
	Thousand acres	Per cent	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres
New England	27,273	6	13,860	7,976	5,884	4,843	6,145	2,425
Middle Atlantic	27,139	5	7,294	26	7,268	10,518	5,998	3,329
Lake	55,895	11	5,095	2,664	2,431	8,880	28,165	13,755
Central 1/	64,249	13	21,224	1,664	19,560	25,592	12,245	5,188
Southeast	191,739	39	57,265	14,338	42,927	52,702	37,236	44,536
Pacific Coast	66,685	13	44,140	38,892	5,248	6,663	6,190	9,672
North Rocky Mt.	32,329	7	17,026	15,172	1,854	5,704	5,933	3,666
South Rocky Mt.	30,570	6	22,741	18,123	4,618	5,959	161	1,709
Total	495,879	100	188,645	98,855	89,790	120,881	102,073	84,280

Table 2 - Stand of saw-timber in the United States, by character of growth and region

Region	Total		Softwoods			Hardwoods		
			Total	Old growth	Second growth	Total	Old growth	Second growth
	Million ft.b.m.	Per cent	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.
New England	57,875	3	32,811	18,977	13,834	25,064	10,295	14,769
Middle Atlantic	26,150	2	8,245	144	8,101	17,905	195	17,710
Lake	35,887	2	9,193	7,656	1,537	26,694	13,327	13,367
Central 1/	34,622	2	2,900	1,146	1,754	31,722	6,332	25,390
Southeast	199,297	12	121,449	37,312	84,137	77,848	32,866	44,982
Pacific Coast	1,041,628	62	1,038,909	957,208	81,701	2,719	1,421	1,298
North Rocky Mt.	146,388	9	146,388	142,680	3,708	..	..	..
South Rocky Mt.	125,956	8	125,955	116,215	9,740	1	1	..
Total	1,667,803	100	1,485,850	1,281,338	204,512	181,953	64,437	117,516

1/ Data for Kansas and Nebraska are not available, hence the forest acreage and timber stand of these two States are not considered in the report. It is estimated that Kansas and Nebraska each contain somewhat more than a million acres of forest land; and that Kansas contains about 700 million board feet of saw timber, Nebraska about 150 million.

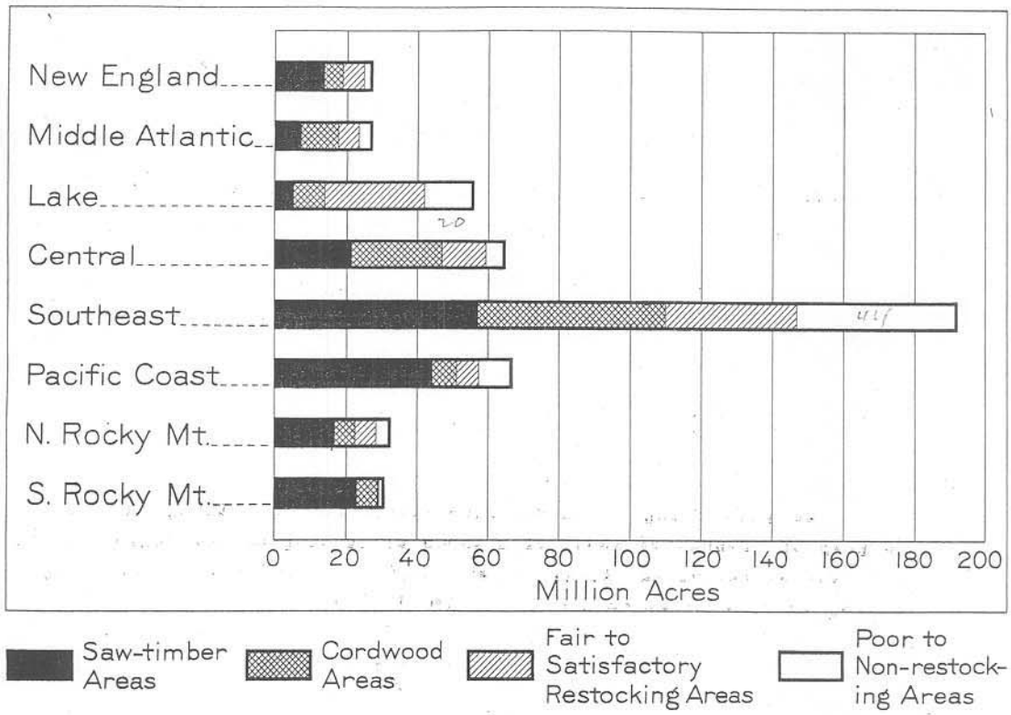

FIG. 2. - FOREST AREA OF THE UNITED STATES BY REGION AND CHARACTER OF GROWTH

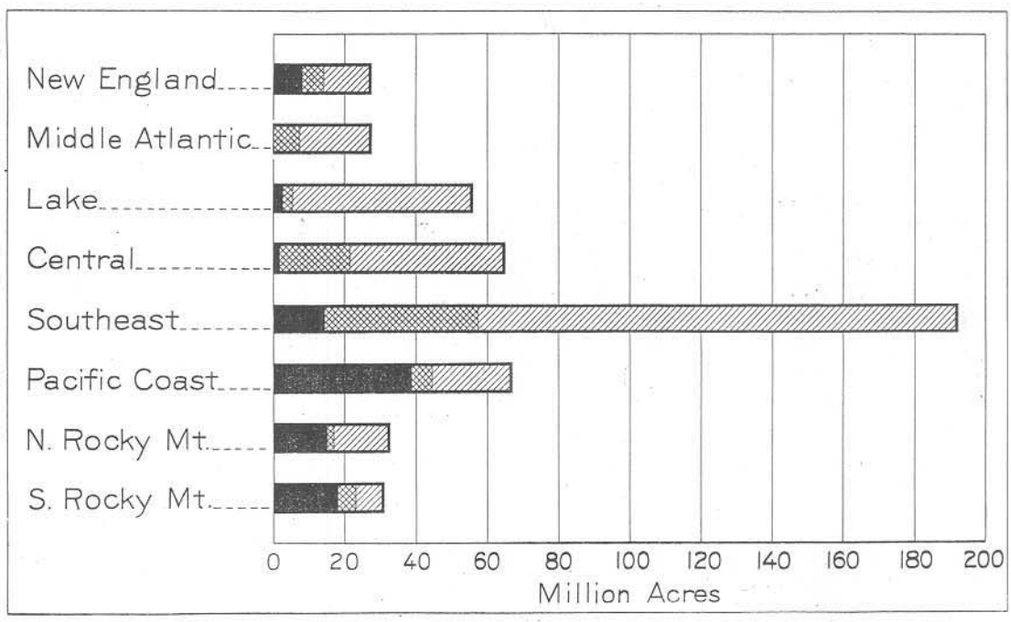

FIG. 3.—OLD-GROWTH AND SECOND-GROWTH SAW-TIMBER AREAS IN RELATION TO TOTAL FOREST AREA OF THE UNITED STATES - 8 - BY REGIONS

prospects are that a considerable acreage of the remaining commercial forest area will ultimately find its way into the non-commodity class.

The commercial forest areas may have increased in recent years, through farm land passing back to forest land. Much of the second-growth timber in the East is on old abandoned farms. It is estimated there is in the neighborhood of 10,000,000 acres of abandoned farm land that is reverting or likely to revert to forest land, which is not included in the present commercial forest area of 496,000,000 acres.

If put and kept continuously at work growing timber of merchantable quality, the present forest acreage is judged to be ample to supply all the country's wood requirements, on the basis of our present requirements. Moreover, with the exception of two or three of the more populous regions, the distribution of the forest land is such that the various regions of the country as regards their probable future wood requirements can become largely self-contained. Of the total forest acreage, the New England, Middle Atlantic, Lake and Central regions together have 35 per cent; the Southeast region 39 per cent; and the Pacific Coast, North Rocky Mountain, and South Rocky Mountain regions 26 per cent. (Table 1.)

Utilization of the original forest has progressed so far that of the present forest area only 20 per cent, or 98,855,000 acres, is virgin forest. Old-growth and second-growth saw-timber areas comprise 38 per cent of the total present forest area, cordwood areas 24 per cent, fair to satisfactory restocking areas 21 per cent, and poor to non-restocking areas 17 per cent. (Table 1 and Figs. 2 and 3.)

An exceedingly unfavorable element in the general forest situation in the United States is seen in the regional distribution of the saw-timber areas. Nearly half of the total saw-timber area, and about three-fourths of the old-growth saw-timber area, are found in the Pacific Coast and Rocky Mountain regions. About one-fourth of the total saw-timber area, and about two-fifths of the old-growth saw-timber area, are found in the extreme western States of Washington, Oregon, and California. The Southeast region, which is now supplying 45 per cent of the country's lumber cut, has only 15 per cent of the country's old-growth saw-timber area. The Middle Atlantic, Lake, Central and New England regions together have only 13 per cent of the old-growth saw-timber area.

One-half of the country's second-growth saw-timber area is in the Southeast region. The Central region ranks second, with one-fifth of the total. The New England region has 6 per cent, the Middle Atlantic 8 per cent, and the Lake 3 per cent.

The Southeast and Central regions are also leaders in cordwood areas, with 44 per cent and 21 per cent, respectively, of the country's total of 121 million acres. The remaining cordwood areas are distributed about equally among the other regions. (Table 1 and Fig. 2.)

In part owing to unavoidable fires, recent cutting, and other causes, but largely the result of wasteful methods of cutting and of neglect of cut and burned-over forest lands, an excessive amount of the country's forest area, or 186 million acres, carries no saw-timber or cordwood stands. (Table 1 and Fig. 2.) This class

of forest land, moreover, is probably increasing. Timberlands are usually cut over much more closely now than formerly, with the result that after fires have killed out most of the young growth on logged-off lands, reproduction is slow to start. At least eight million acres of forest land are cut over every year.

About one-sixth of the country's forest area, or about 84 million acres, is either poorly restocked or carries little or no young growth. The bulk of this area, because of the scattered stocking, the species, the quality of growth, or for other reasons, can not reasonably be expected to develop into a commercially valuable stand within the period required for the existing growth to reach merchantable size. Half of the area is practically deforested.

Alaska

All of Alaska, excepting a relatively narrow coastal strip in the south, has much the same vegetative cover as other countries similarly located. The valley floors and lower slopes support patchy stands of small, slow-growing trees interspersed with tracts of brush and tundra. On the upper slopes these types give way to brush and grass, and finally to barren rocks on the higher mountains. The extreme northern and northwestern sections, including the drainages tributary to the Arctic Ocean and a strip of land extending inland from 100 to 150 miles along the shores of Bering Sea, have practically no tree growth. South of the crest of the high Pacific Mountain System, which parallels and largely adjoins the southern coast of Alaska, are the extensive and dense stands of western hemlock and Sitka spruce of the "coast forest."

The coast forest, which is of particular interest, occupies the lower slopes of the islands and an adjacent strip of mainland on the southern coast of Alaska from Dixon Entrance on the British Columbia boundary, northerly and westerly to Afognak Island and a nearby point on the Alaska Peninsula. As it is confined to elevations below 2,500 feet and as the region is one of rough topography, the forest occurs in narrow bands adjacent to the line of the seacoast, rarely reaching inland more than five miles except along the few large rivers. It embraces an area of over 6 million acres; somewhat more than 5 million acres of saw timber, and somewhat less than one million acres of cordwood. It is composed of a mixture of western hemlock and sitka spruce, with a small percentage of western red cedar and Alaska cedar; the saw-timber stand is estimated at about 80 billion board feet, the cordwood stand at about 8 million cords.

Most of the timber of the coast forest is readily accessible for logging operations; it is estimated that 75 per cent of the commercial timber is within 2½ miles of tidewater. However, in volume per acre, size of trees, and prevalence of defect, the timber suffers in comparison with that of the same type in southern British Columbia, Washington, and Oregon. The average stand per acre is lower, being around 16,000 board feet, and the average tree is smaller, with a diameter of about two feet and a height of 80 to 100 feet. Decay is a more serious feature of the mature and over-mature stands, especially in the hemlock trees. Trees with dead spike tops are a conspicuous feature in most parts of the coast forest. Moreover, there are extensive open stands of somewhat dwarfed trees of little commercial value.

The Forest Service, which administers 98 per cent of the timber volume in the coast forest, is committed to a policy of managing the national forest areas primarily for pulp and paper production. Western hemlock and Sitka spruce, the predominating species, are excellent pulping woods. The trees are of a size and quality better suited for pulping than for lumber production. Pulp products have a higher unit value than lumber and hence can stand a higher shipping charge from this quite remote region to the general markets. Excellent water power resources are also available.

Saw-timber Stands

The present stand of saw timber in the continental United States amounts to 1,668 billion board feet, or about one-third of the original stand. Of this 1,486 billion board feet, or 89 per cent, is softwood and 182 billion hardwood. Present old-growth saw timber amounts to 1,346 billion board feet, or about 80 per cent of the total. (Table 2 and Fig. 4.)

The exhaustion of the eastern stands of saw timber and the steady progress of the lumber industry toward the West is well indicated by the location of the remaining supplies of saw timber. Thus, the New England, the Middle Atlantic, Central, and Lake regions, with 35 per cent of the country's forest area contain only 155 billion board feet of saw timber or less than 10 per cent of the country's total supply. The Southeast region has 39 per cent of the total forest area and only 12 per cent of the total saw timber. The Pacific Coast region, with 13 per cent of the forest area, contains about 1,042 billion board feet or 62 per cent of the total saw timber. Four-fifths of the present stand of saw timber in the United States is west of the Great Plains.

In other words, the depletion of our forest resources has reached the point where the one great reservoir of softwood timber still left lies on the Pacific Coast, chiefly in the Pacific Northwest. For years the softwood stands of the New England, Middle Atlantic, Central, and Lake regions have contributed but little to the softwood lumber production of the country. And the Southeast region, because of waning saw-timber supplies, has been losing the commanding position which it held for 20 or 30 years.

Douglas fir, with an estimated total stand of 530 billion board feet, approximately 80 per cent of which is in the two States of Oregon and Washington, is the principal species in the West. Western yellow pine is a fair second, with a total stand of approximately 252 billion board feet, 13 per cent of which is in the North Rocky Mountain region, 17 per cent in the South Rocky Mountain region, and 70 per cent in the Pacific Coast region. Following these two species, which together comprise half of the softwood timber in the entire country, come the true firs, western hemlock, spruce, redwood, and sugar pine, all important commercial species of the West, with an aggregate stand of more than 370 billion board feet. (Table 3 and Fig. 5.)

In the East the only softwood with a stand comparable to any of these is southern yellow pine, which includes several species, with a total of 118 billion board feet, or slightly less than one-half the stand of western yellow pine. Spruce and fir come next, with a stand of about 22 billion board feet, followed by white and

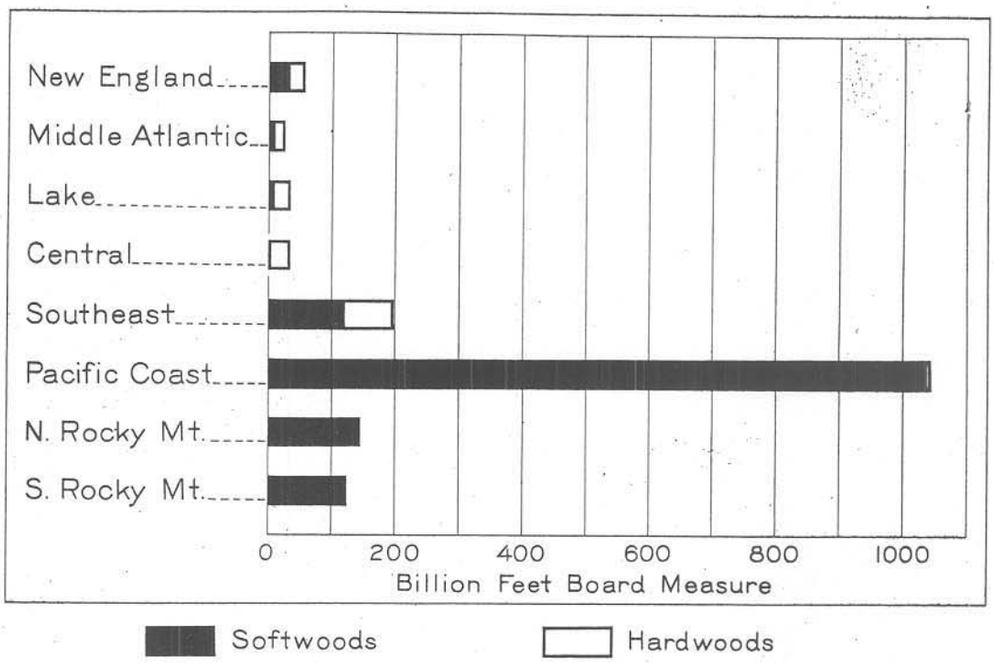

FIG. 4 - SAW-TIMBER STAND OF THE UNITED STATES BY REGIONS

Table 3 - Stand of saw-timber in the United States, by region and kind of wood

Kind of wood	Total	New England	Middle Atlantic	Lake	Central	Southeast	Pacific Coast	North Rocky Mt.	South Rocky Mt.
	Million ft. b.m.	Million ft. b.m.	Million ft. b.m.	Million ft. b.m.	Million ft. b.m.	Million ft. b.m.	Million ft. b.m.	Million ft. b.m.	Million ft. b. m.
Eastern hardwoods									
Oak	60,753	1,048	4,783	6,017	16,315	32,590	..	..	..
Birch, beech, and maple	49,943	20,973	8,555	13,459	4,401	2,555	..	..	..
Red gum	15,488	..	71	..	874	14,543	..	..	..
Tupelo	6,342	..	..	..	116	6,226	..	..	..
Yellow poplar	5,172	18	203	..	1,635	3,316	..	..	..
Cottonwood and aspen	4,437	2,022	20	887	222	1,286	..	..	..
Others	37,098	1,003	4,273	6,331	8,159	17,332	..	..	..
Total	179,233	25,064	17,905	26,694	31,722	77,848	..	..	..
Eastern softwoods									
Southern yellow pine	118,132	..	597	..	1,433	116,102	..	..	..
Spruce and fir	21,533	18,720	1,564	843	175	231	..	..	..
White and Norway pine	14,672	8,390	3,530	2,392	159	201	..	..	..
Hemlock	12,198	3,675	2,462	4,612	765	684	..	..	..
Cypress	4,140	..	..	..	263	3,877	..	..	..
Others	3,923	2,026	92	1,346	105	354	..	..	..
Total	174,598	32,811	8,245	9,193	2,900	121,449	..	..	..
Western hardwoods	2,720	..	..	..	..	..	2,719	..	1
Western softwoods									
Douglas fir	530,197	..	..	..	..	..	484,138	33,933	12,126
Western yellow pine	251,560	..	..	..	..	..	178,051	31,928	41,571
True firs	131,933	..	..	..	..	..	109,196	14,594	8,143
Western hemlock	86,464	..	..	..	..	..	86,464	..	..
Spruce	61,582	..	..	..	..	..	12,782	12,513	36,287
Redwood	57,233	..	..	..	..	..	57,233	..	..
Lodgepole pine	43,276	..	..	..	..	..	2,143	14,556	26,577
Sugar pine	35,516	..	..	..	..	..	35,516	..	..
Western larch	26,118	..	..	..	..	..	8,043	18,075	..
Western white pine	19,508	..	..	..	..	..	3,944	15,564	..
Others	67,865	..	..	..	..	..	61,399	5,215	1,251
Total	1,311,252	..	..	..	..	..	1,038,909	146,388	125,955
All species	1,667,803	57,875	26,150	35,887	34,622	199,297	1,041,628	146,388	125,956

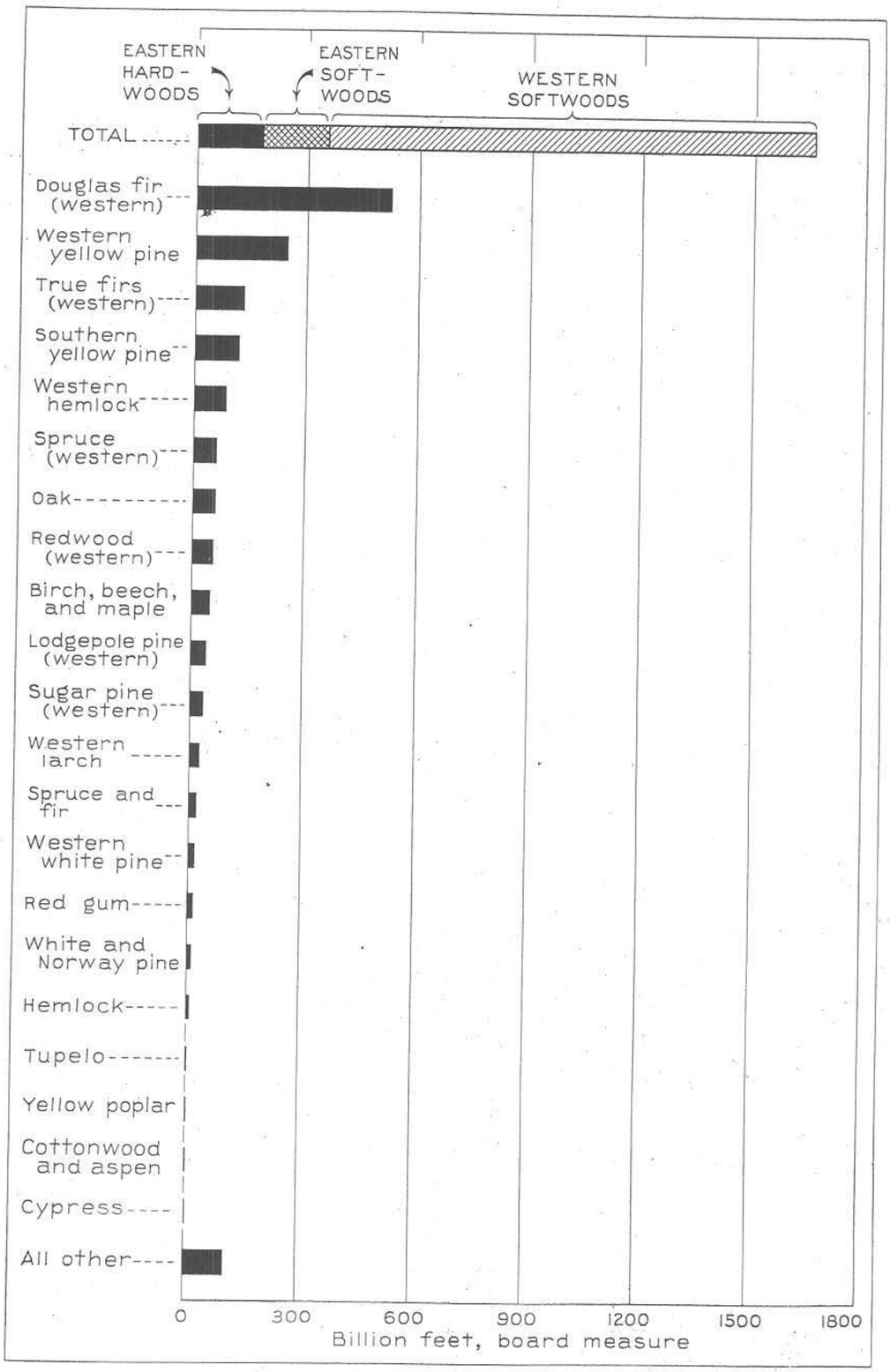

FIG. 5 - SAW-TIMBER STAND OF THE UNITED STATES BY IMPORTANT SPECIES

Norway pine, hemlock, and cypress. The stand of these six species together is considerably less than half the stand of southern yellow pine, and less than 4 per cent of the total stand of softwoods. The stand of white pine, once one of the largest, is strikingly small.

Of the 180 billion board feet of eastern hardwoods, the Southeast region has about 45 per cent, the Middle Atlantic region 10 per cent, and the New England, Lake, and Central regions have each about 15 per cent. Of the 78 billion feet of hardwood in the Southeast region, 33 billion is old-growth timber, comprising the only large reserve of old-growth hardwood timber left in the United States. The New England and Lake regions contain, respectively, 10 and 13 billion feet of old-growth, which because of relatively poor quality, scattered occurrence, etc., can not be counted on to contribute any large proportion of high-class material to the hardwood industries. Oak is the leading hardwood of the country, with a total stand of about 60 billion board feet, followed by birch, beech, and maple, which together have a stand of 50 billion board feet. Three of the most valuable hardwoods - hickory, ash, and yellow poplar - together have an estimated stand of 15 billion board feet, or less than 1 per cent of the total stand of the United States. The hardwoods constitute about 10 per cent of the saw-timber stand of the country, as against over 25 per cent of the saw-timber cut.

Volume of Cordwood

The present volume of cordwood material in the country amounts to nearly 2,400 million cords, or nearly 30 times the quantity of fuelwood and pulpwood cut annually from our forests. The cordwood on cordwood areas represents 46 per cent of the total; that in small trees on saw-timber areas, 33 per cent; and that in tops and limbs (tops only, in softwood species) of trees of saw-timber size, 21 per cent. (Tables 4 and 5, Figs. 6 and 7.)

Only a part of the existing store of cordwood should be thought of as available for present commodity use. If the cordwood on the cordwood areas and small trees on saw-timber areas generally were to be handled without proper regard for future saw-timber requirements, inadequate supplies of saw timber throughout the entire country would unquestionably result in a comparatively short time; it is the faulty treatment of small trees in the past that has resulted, in a large measure, in the present dearth of suitable saw timber in several of our forest regions. The 486 million cords of cordwood in the tops and limbs of saw-timber trees, of course, should be utilized as extensively as possible. However, if the future can be judged by the present, the bulk of such material is likely to serve no useful purpose. Because of comparatively poor quality, lack of nearby markets, or other reasons, tops and limbs left in saw-log operations are utilized only to a small extent at present.

Of the 1,100 million cords of cordwood embraced in the cordwood areas, about a half is eastern hardwood and nearly a third is eastern softwood. Oak and southern yellow pine each represent about a fifth of the total. (Table 6 and Fig. 8.)

The stand on the cordwood areas averages only about 9 cords to the acre. This low average is in itself a striking indication of failure to secure a satisfactory restocking of our cut-and burned-over lands. This failure will have increas-

Table 4 - Stand of cordwood on cordwood and saw-timber areas, by regions

Region	Total		Cordwood areas			Saw-timber areas		
			Total	Softwood	Hardwood	Total	Softwood	Hardwood
	Thousand cords	Per cent	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords
New England	149,913	6	56,801	14,555	42,246	93,112	20,238	72,874
Middle Atlantic	179,002	8	125,641	15,873	109,768	53,361	11,154	42,207
Lake	170,690	7	123,398	37,207	86,191	47,292	10,400	36,892
Central	252,273	11	156,338	10,720	145,618	95,935	5,455	90,480
Southeast	792,339	33	429,900	262,959	166,941	362,439	181,797	180,642
Pacific Coast	429,863	18	75,906	75,386	520	353,957	353,131	826
North Rocky Mt.	263,212	11	104,604	104,604	..	158,608	158,608	..
South Rocky Mt.	144,805	6	29,555	29,282	273	115,250	115,250	..
Total	2,382,097	100	1,102,143	550,586	551,557	1,279,954	856,033	423,921

Table 5 - Stand of cordwood on saw-timber areas, by type of material and region

Region	Total		Small trees 1/			Tops and limbs 2/		
			Total	Softwood	Hardwood	Total	Softwood	Hardwood
	Thousand cords	Per cent	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords
New England	93,112	7	69,872	12,036	57,836	23,240	8,202	15,038
Middle Atlantic	53,361	4	40,556	9,095	31,461	12,805	2,059	10,746
Lake	47,292	4	28,855	8,103	20,752	18,437	2,297	16,140
Central	95,935	8	75,114	4,730	70,384	20,821	725	20,096
Southeast	362,439	28	280,104	151,436	128,668	82,335	30,361	51,974
Pacific Coast	353,957	28	103,179	102,897	282	250,778	250,234	544
North Rocky Mt.	158,608	12	120,264	120,264	..	38,344	38,344	..
South Rocky Mt.	115,250	9	76,243	76,243	..	39,007	39,007	..
Total	1,279,954	100	794,187	484,804	309,383	485,767	371,229	114,538

1/ Less than saw-timber size but large enough to produce cordwood.

2/ Of saw-timber trees; only the tops in case of softwoods.

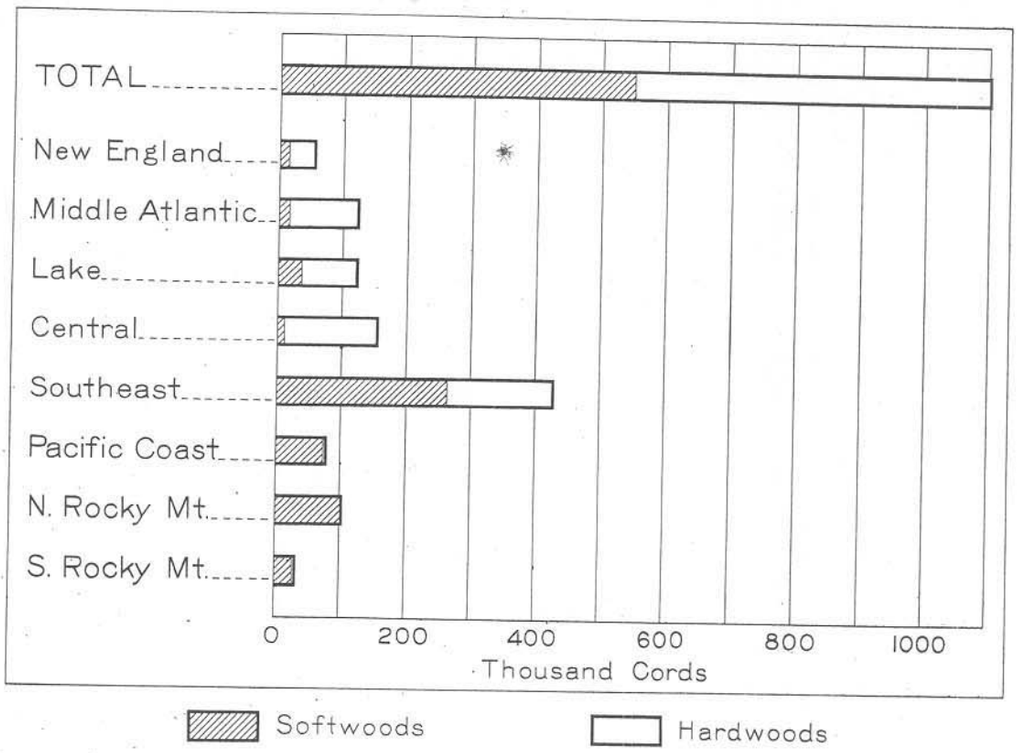

FIG. 6.- STAND OF CORDWOOD ON CORDWOOD AREAS BY REGIONS

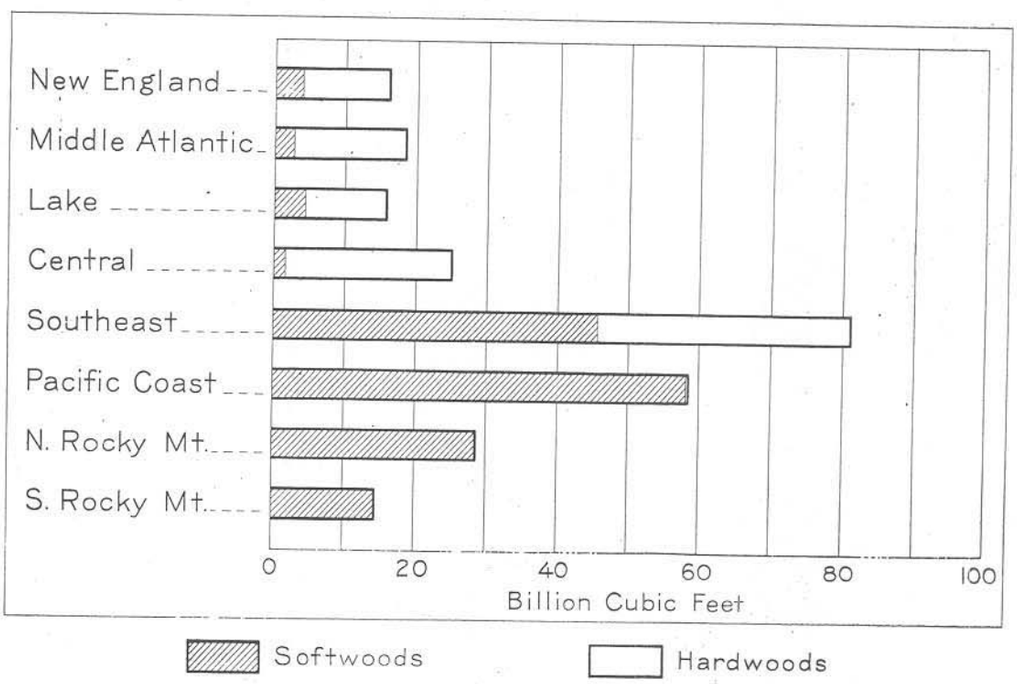

FIG. 7. - TOTAL STAND OF CORDWOOD, INCLUDING MATERIAL ON CORDWOOD AND RESTOCKING AREAS, SMALL TREES ON SAW-TIMBER AREAS, AND TOPS AND LIMBS OF SAW-TIMBER TREES, IN CUBIC FEET, BY REGIONS

Table 6 - Stand of cordwood on cordwood areas, by region and kind of wood

Kind of wood	Total	New England	Middle Atlantic	Lake	Central	Southeast	Pacific Coast	North Rocky Mt.	South Rocky Mt.
	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords
Eastern hardwoods									
Oak	232,327	8,898	38,871	25,955	77,672	80,931	..	..	..
Birch, beech and maple	126,484	28,847	38,058	39,727	13,600	6,252	..	..	..
Red gum	25,136	..	1,117	..	4,408	19,611	..	..	..
Yellow poplar	19,146	80	2,616	..	5,469	10,981	..	..	..
Cottonwood and aspen	14,068	2,259	1,681	8,265	751	1,012	..	..	..
Tupelo	7,206	..	..	..	551	6,655	..	..	..
Others	126,397	2,162	27,425	12,144	43,167	41,499	..	..	..
Total	550,764	42,246	109,768	86,191	145,618	166,941	..	..	..
Eastern softwoods									
Southern yellow pine	268,601	..	7,046	..	5,602	255,953	..	..	..
Spruce and fir	22,158	5,308	1,462	15,303	18	67	..	..	..
White and Norway pine	13,360	6,386	4,488	1,254	310	922	..	..	..
Hemlock	8,324	2,669	2,064	455	1,372	1,764	..	..	..
Cypress	3,730	..	..	..	1,380	2,350	..	..	..
Others	25,141	192	813	20,195	2,038	1,903	..	..	..
Total	341,314	14,555	15,873	37,207	10,720	262,959	..	..	..
Western hardwoods	793	..	..	..	..	..	520	..	273
Western softwoods									
Lodgepole pine	90,657	..	..	..	..	..	16,214	61,791	12,652
Douglas fir	60,666	..	..	..	..	..	40,416	17,181	3,069
Western yellow pine	16,414	..	..	..	..	..	2,563	9,618	4,233
True firs	11,535	..	..	..	..	..	4,596	4,831	2,108
Spruce	6,569	..	..	..	..	..	286	1,687	4,596
Western larch	6,434	..	..	..	..	..	328	6,106	..
Western hemlock	5,220	..	..	..	..	..	5,220	..	..
Western white pine	3,778	..	..	..	..	..	1,147	2,631	..
Sugar pine	48	..	..	..	..	..	48	..	..
Others	7,951	..	..	..	..	..	4,568	759	2,624
Total	209,272	..	..	..	..	..	75,386	104,604	29,282
All species	1,102,143	56,801	125,641	123,398	156,338	429,900	75,906	104,604	29,555

ingly serious consequences, as depletion of the old-growth forests makes us more and more dependent on second-growth timber.

Pulpwood Supplies

The tendency in pulp and paper manufacture, as in other forms of wood utilization, is toward an increase in the number of species regarded as suitable, with a consequent enlargement of the volume of potential pulpwood supplies. The species that are economically suitable at present can be listed only with a fair degree of accuracy. Then, too, existing stands of timber must not only meet the requirements for a large number of other important forest products, such as lumber, fuelwood, ties, etc., but their treatment must be such that a plentiful supply of suitable wood will be assured for the future through an adequate reserve of selected growing stock. These and other factors make a thoroughly satisfactory estimate of present pulpwood supplies impossible. Any attempt to predict nicely the proportion of the various timber stands, including saw timber and cordwood, that ultimately may be utilized as pulpwood would be futile.

Including the stand of saw timber, small trees on saw-timber areas, and the stand on cordwood areas, we have more than 1,800 million cords of the principal species now used for pulp and paper, or about one-third of the total volume of all species and forms of forest material on the forest area of the continental United States. (Table 7.) Largely because of the inclusion of the southern yellow pines in the estimate (species suitable for the sulphate process but relatively little used thus far), the Southeast is shown to have 42 per cent of the total supply of pulpwood. The Pacific Coast region, with only the three standard pulping species of that region listed, has 20 per cent of the total; the New England region 11 per cent, Lake region 8 per cent, Middle Atlantic and South Rocky Mountain each 6 per cent, Central region 4 per cent, and the North Rocky Mountain region 3 per cent. The above estimate does not take into account the stands of western hemlock and Sitka spruce in Alaska, which amount to more than 160 million cords, or a somewhat larger supply than that in the Lake region.

Of the total of 1,800 Willion cords about one-third is made up of spruce, fir, and hemlock. These species are especially desired for mechanical and sulphite pulps, which represent about three-fourths of our wood-pulp requirements. Excluding the Alaskan supply, the Pacific Coast region has about 60 per cent of the total spruce-fir-hemlock pulpwood, the South Rocky Mountain region nearly 20 per cent, the New England and North Rocky Mountain regions each about 8 per cent and the Lake region about 5 per cent. All of the Alaskan pulpwood falls within the sulphite-mechanical group.

About 500 millions of the 1,800 million cords consist of cottonwood, aspen, yellow poplar, birch, beech, maple, and gum, species used mostly for soda pulp. The remainder of the estimated pulpwood supply includes southern yellow, white, Norway, and jack pine, species used largely for sulphate pulp.

In addition to the standard pulping species of the West listed in Table 7, there are a number of woods in that region which either are used to a limited extent in paper manufacture or known to be suitable. They include Douglas fir, western

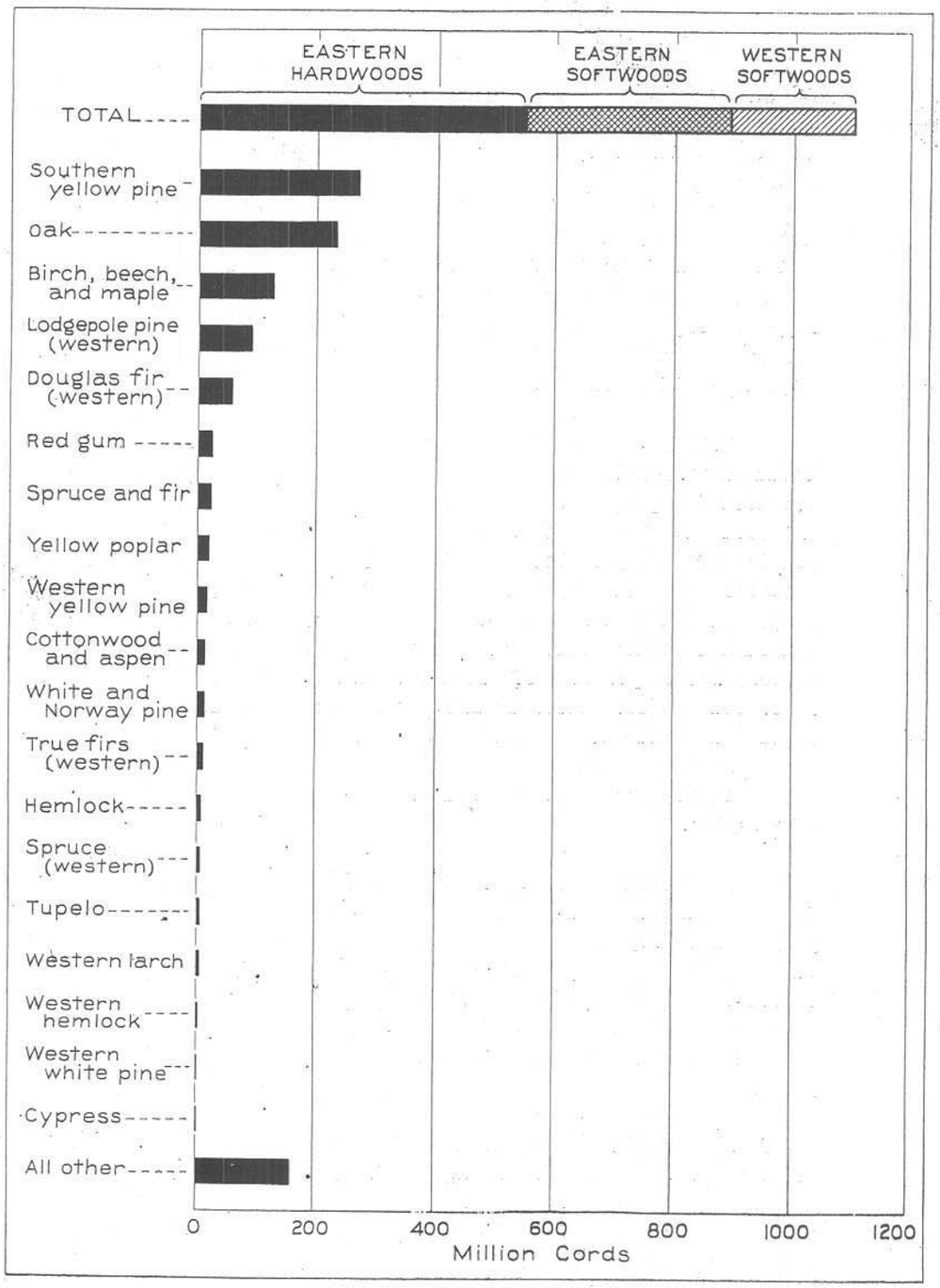

FIG. 8 - STAND OF CORDWOOD ON CORDWOOD AREAS BY IMPORTANT SPECIES

Table 7 - Stand of principal kinds of wood now used in pulp and paper manufacture, by regions

Kind of wood	Total 1/	New England	Middle Atlantic	Lake	Central	Southeast	Pacific Coast	North Rocky Mt.	South Rocky Mt.
	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords	Thousand Cords
Softwoods									
Spruce and fir	431,242	45,030	5,931	17,526	610	781	205,861	2/ 48,174	107,329
Hemlock	206,825	10,467	9,100	12,619	3,962	3,883	166,794	..	..
Southern yellow pine	623,525	..	8,751	..	10,453	604,321	..	..	..
White, Norway and jack pine	66,404	24,190	14,575	25,242	848	1,549	..	..	..
Tamarack	1,986	14	..	1,972	..	..	..	..	..
Total	1,329,982	79,701	38,357	57,359	15,873	610,534	372,655	48,174	107,329
Hardwoods									
Cottonwood and aspen	30,463	10,590	1,752	10,662	1,651	5,535	..	..	273
Yellow poplar	38,702	152	3,338	..	12,090	23,122	..	..	..
Birch, beech and maple	305,404	115,235	68,581	74,610	31,430	15,548	..	..	..
Gum	124,694	..	2,601	..	9,070	113,023	..	..	..
Total	499,263	125,977	76,272	85,272	54,241	157,228	..	..	273
All species	1,829,245	205,678	114,629	142,631	70,114	767,762	372,655	48,174	107,602

1/ Includes material suitable for saw logs, small trees on saw-timber areas, and cordwood on cordwood areas.

2/ Includes western hemlock

yellow pine, western white pine, sugar pine, lodgepole pine, and western larch, the saw-timber stand of which amounts to 1,800 million cords.

Total Volume of Timber

The total volume of standing timber in the country, including cordwood and larger trees on restocking areas as well as similar material on saw-timber and cordwood areas, is estimated at 487 billion cubic feet, 358 billion of softwood and 129 billion of hardwood. (Table 8 and Fig. 9.) Nearly half, or 229 billion cubic feet, is saw-log material. The volume of small trees on saw-timber areas is about 70 billion cubic feet, and that on cordwood areas 100 billion cubic feet. The volume of wood in tops, limbs, stumps, long butts, breakage, and the like, amounts to nearly 70 billion cubic feet, or nearly 15 per cent of the total volume of standing timber; the bulk of this material falls in the category of wood waste.

Figure 10 shows the very unsatisfactory distribution of both the saw-timber stand and the total stand, by regions. New England has about the same forest area as the Middle Atlantic region, and yet has more than twice as much saw timber. It has less than one-half the forest area of the Central and Lake regions, but on the other hand has almost twice the saw timber of either. The Pacific Coast region has about the same forest area as the Central and Lake regions, and yet has 30 times as much saw timber as either. With only about one-third of the forest area of the Southeast region, the Pacific Coast region has more than five times as much saw timber. Although the North Rocky Mountain region has but little more forest area than the Middle Atlantic region, it has more than five times as much saw timber.

Estimates in terms of cubic feet afford the only basis for comparing directly the volume of the total timber stand with the total volume of timber growth or the total volume of timber depletion; without a common unit of measure, timber stand, timber growth, and timber depletion can not be compared, one with the other. It may prove misleading to compare different estimates in cubic feet of the same stand of timber, unless one knows that the same conversion factors, similarly applied, were used in each case. The present estimate in cubic feet of the total volume of timber in the United States, for example, is lower than a previous estimate of te Forest Service, the difference being due in part to the use of different conversion factors but mostly to depletion.

OWNERSHIP OF FORESTS

Forest Land

The character of forest land ownership is important from the standpoint of stability, permanence of interest in the land as distinct from merchantable standing timber, and ability to finance the requisite timber-growing operations through the eriods required to produce commercial products. Of the 496 million acres of commercial forest land in the continental United States, approximately 88 million acres are owned or managed by the Federal Government, 15,434,000 acres by the States, and 1,199,000 acres by counties and municipalities. (Table 9 and Fig. 11.) These holdings, which only aggregate 21 per cent of the total, represent the most stable forest land ownership in the country and in this respect the most favorable for the continuous production of timber crops.

Table 8 - Total stand in cubic feet of soft woods and hardwoods on saw-timber, cordwood, and restocking areas, by type of material and region

Region	Total area			Saw-timber areas								Cordwood and restocking areas	
	Total stand	Soft-wood	Hard-wood	Saw timber 1/		Small trees 2/		Tops & limbs 3/		O t h e r 4/		Soft-wood	Hard-wood
				Soft-wood	Hard-wood	Soft-wood	Hard-wood	Soft-wood	Hard-wood	Soft-wood	Hard-wood		
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million cu. ft.
New England	25,230	9,098	16,132	5,183	4,086	1,082	5,205	738	1,353	260	286	1,835	5,202
Middle Atlantic	22,649	4,031	18,618	1,302	2,918	819	2,831	185	968	64	204	1,661	11,697
Lake	21,550	5,810	15,740	1,453	4,359	729	1,867	206	1,452	73	305	3,349	7,757
Central	30,656	2,080	28,576	458	5,235	425	6,334	65	1,809	22	366	1,110	14,832
Southeast	113,811	64,963	48,848	19,190	13,523	13,629	11,578	2,733	4,678	960	947	28,451	18,122
Pacific Coast	191,732	191,176	556	132,917	351	9,243	25	22,520	49	17,540	56	8,956	75
N. Rocky Mt.	47,768	47,768	..	19,269	..	10,824	..	3,451	..	2,076	..	12,148	..
S. Rocky Mt.	33,323	33,299	24	18,815	..	6,860	..	3,509	..	1,465	..	2,650	24
Total	486,719	358,225	128,494	198,587	30,472	43,611	27,840	33,407	10,309	22,460	2,164	60,160	57,709

1/ Only the portion of tree suitable for saw logs.

2/ Less than saw-timber size but large enough to produce cordwood.

3/ Of saw-timber trees; only the tops in the case of softwoods.

4/ Stumps, long butts, and breakage.

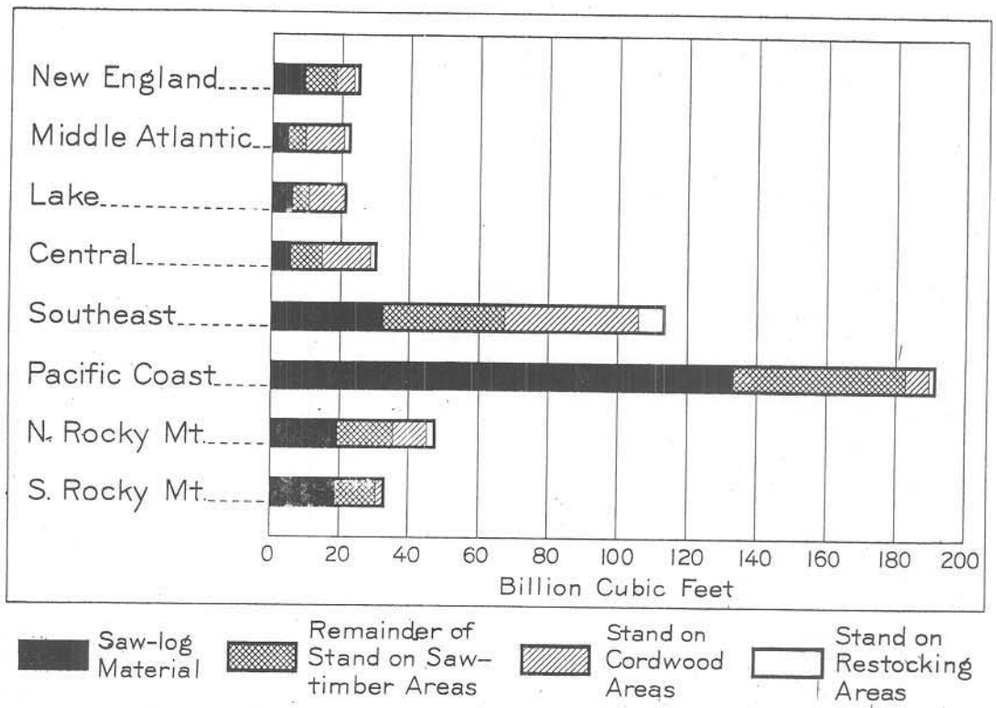

FIG. 9 - TOTAL STAND IN CUBIC FEET ON SAW-TIMBER AREAS, CORDWOOD AREAS, AND RESTOCKING AREAS BY REGIONS

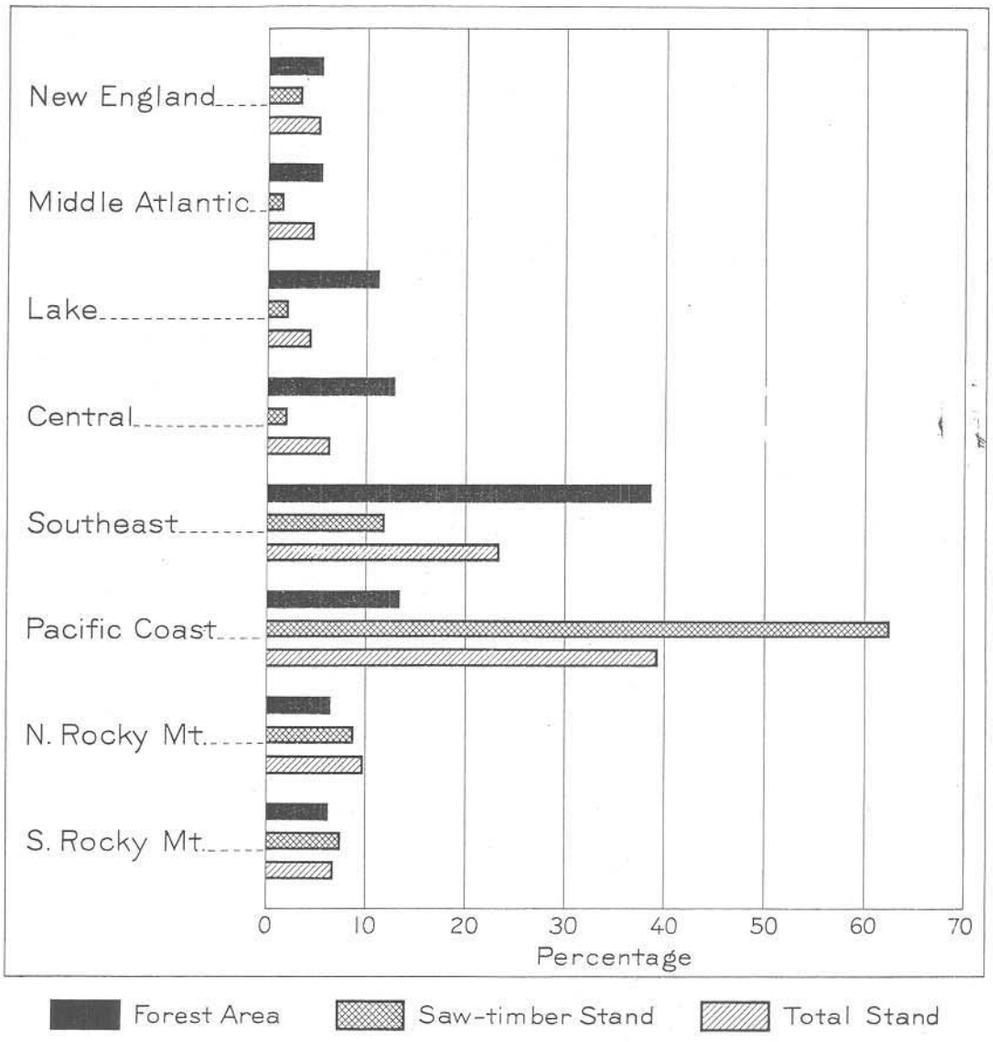

FIG. 10 – PERCENTAGE DISTRIBUTION OF TOTAL FOREST AREA, OF TOTAL SAW-TIMBER STAND AND OF TOTAL STAND, BY REGIONS

Table 9 - Ownership of present forest areas of the United States, by regions

Region	All areas	Federally owned or managed				State county, and municipal	Private		
		Total	National forest	Indian reservation	Other		Total	Farm woodlot	Other
	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres
New England	27,273	471	471	..	..	825	25,977	6,400	19,577
Middle Atlantic	27,139	348	317	..	31	1,861	24,930	9,454	15,476
Lake	55,895	2,955	1,800	1,140	15	3,867	49,073	12,245	36,828
Central	64,249	581	579	..	2	191	63,477	32,158	31,319
Southeast	191,739	3,213	3,137	56	20	1/ 6,281	182,245	57,866	124,379
Pacific Coast	66,685	31,812	26,047	3,413	2,352	1,837	33,036	5,099	27,937
North Rocky Mt.	32,329	23,725	22,036	833	856	1,266	7,338	1,413	5,925
South Rocky Mt.	30,570	24,924	20,293	1,986	2,645	505	5,141	43	5,098
Total	495,879	88,029	74,680	7,428	5,921	16,633	391,217	124,678	266,539

1/ Largely tax-delinquent land, the final status of which has not been determined.

Table 10 - Ownership of saw-timber areas, by regions

Region	All areas	Federally owned or managed				State county, and municipal	Private		
		Total	National forest	Indian reservation	Other		Total	Farm woodlot	Other
	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres
New England	13,860	248	248	..	..	351	13,261	2,427	10,834
Middle Atlantic	7,294	30	29	..	1	64	7,200	3,468	3,732
Lake	5,095	474	353	121	..	197	4,424	1,720	2,704
Central	21,224	220	218	..	2	83	20,921	12,158	8,763
Southeast	57,265	1,041	1,884	49	8	104	55,220	13,729	41,491
Pacific Coast	44,140	24,129	19,852	2,815	1,462	1,104	18,907	1,740	17,167
North Rocky Mt.	17,026	12,623	11,605	573	445	849	3,554	364	3,190
South Rocky Mt.	22,741	19,612	15,606	1,746	2,260	351	2,778	34	2,744
Total	188,645	59,277	49,795	5,304	4,178	3,103	126,265	35,640	90,625

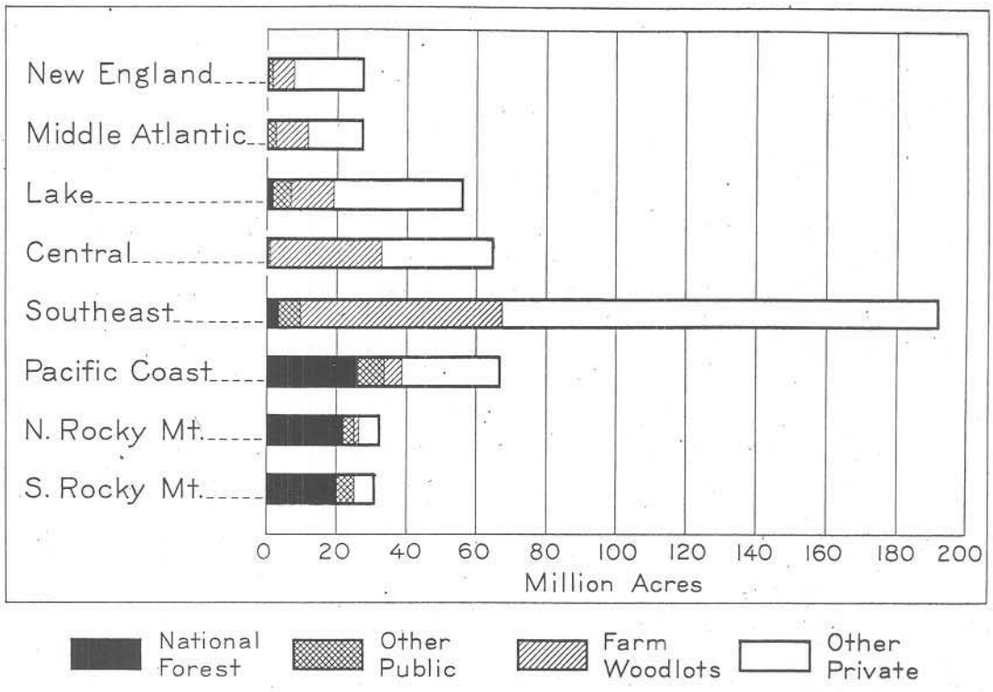

FIG. 11. - OWNERSHIP OF FOREST AREA OF THE UNITED STATES BY REGIONS

LKE-DEC. 1931
E.L.M.

The area within the national forests, which includes 75 million acres of commercial forest land, is administered for the purpose of conserving the natural resources, including timber, water for domestic use, irrigation and power, forage, recreation, and wild life. The principal purpose of the national forests is the growing of timber through the application of forestry methods -- protection against fire and other destructive agencies, harvesting the timber crops when ripe in such a way that they will be replaced by young forests, and other measures designed to keep timber growing in merchantable quantities on lands best suited for that purpose.

The growing of timber on public lands can not take the place of the growing of timber on private holdings, but is intended rather to encourage and supplement private endeavors. Public ownership is recognized in many countries as the chief safeguard against any general tendency toward destructive forest exploitation. In many cases it is accompanied by public control of private exploitation. Such public undertakings are a recognition of the difficulty experienced by private ownership in coping with forest problems without some public leadership and assistance.

An expanded Federal forest purchase program could be made to serve as a measure of public security against destructive forest exploitation and as a means of withdrawing low-grade farm lands from profitless cultivation. Its present limited scope, however, renders it wholly inadequate to serve these ends. One of the most promising means of restricting destructive forest exploitation is through a large increase in Federal and State acquisition.

Slightly more than 90 per cent of the Federally owned or managed forest land is in the West; the Pacific Coast region contains 36 per cent of this total, the South Rocky Mountain region 28 per cent, and the North Rocky Mountain region 27 per cent.

Each forest region contains more or less State, county, or municipally-owned forest land, but in no case as much as might be considered desirable. State ownership lags far behind Federal.

Of about 391 million acres of forest land in private ownership in continental United States, including the best and most accessible forest land, approximately 125 million is in farm woodland, and about 95 per cent of this woodland is in the East. Half of the total forest area in the Central region, approximately a third in the Middle Atlantic and Southeast regions, and less than a fourth in the New England and Lake regions, is in farm woodland. Much of this general class of land is capable, economically, of rapid development in systematic timber cropping.

The remaining 266 million acres represent the holdings of land and lumber companies, mining companies, railroads, and other owners having in the vast majority of cases no permanent interest in the land except as timber growing may offer commercial profit.

Although destructive forest practices have been abolished in most public forests, they still hold sway in the large bulk of our private forests, which constitute four-fifths of the forest area. The critical problem is to improve methods of handling private forests. There are three methods of approach: (1) The strengthening of public assistance to forest owners in protection, planting, research, and tax reform; (2) The extension of public cooperation to include joint working out of-

better forest practices; and (3) where necessary to protect the public interest, the adoption of restrictive measures against specific destructive practices.

Saw-Timber Area

Of the 189 million acres in saw timber, 126 million, or about 67 per cent, is in private ownership; that in farm woodlands, principally in the Central and Southern regions, amounts to 36 million acres. The Federal Government owns or manages about 30 per cent of the saw-timber area estimated for the continental United States, and the States, counties, and municipalities only two per cent. (Table 10 and Fig. 12.) Of the 59 million acres of saw timber owned or managed by the Federal Government, 95 per cent is in the West, 41, 33, and 21 per cent, respectively, in the Pacific Coast, South Rocky Mountain, and North Rocky Mountain regions.

Cordwood and Restocking Areas

The large proportion of both cordwood and restocking areas held in private ownership especially emphasizes the need for at least an extension and intensification of fire protection -- the first step toward forest culture -- on all types of forest land and in all classes of ownership. Of the 121 million acres in cordwood, 105 million, or nearly 90 per cent, is in private ownership; that in farm woodlands amounts to over 40 million acres. The Federal Government owns or manages only 11 per cent of the cordwood area, and the States, counties, and municipalities but 2 per cent. (Table 11, and Fig. 13.) As with the saw-timber areas, the bulk, or about 90 per cent, of the Federally owned or managed cordwood area is in the West.

About 90 per cent of the fair to satisfactory restocking area of 102 million acres is in private ownership. The Federal Government owns or manages nearly 8 million acres of this type of land, the States and counties over 5 million acres. And about the same proportion of the 84 million acres of poor to non-restocking forest land is in private ownership. (Table 12 and Figs. 14 and 15.)

Saw-timber Stand

Sixty per cent of the total saw-timber stand of 1,668 billion board feet, including the best and most accessible timber, is in private ownership, and 552 billion board feet, or 33 per cent, is included in the national forests. (Table 13 and Fig. 16.) About 32 billion board feet, or two per cent is administered by the Indian Service. Of the remaining 53 billion board feet of Federally owned or managed timber, 41 billion is involved in the Oregon and California land grants. States, counties, and municipalities together hold 42 billion board feet, or three per cent of the total. Of the privately owned stand of 988 billion feet, 123 billion feet is in the farm woodland.

Cordwood Stand

Eighty-four per cent of the 1,100 million cords of cordwood on the total cordwood areas of the country is in private ownership, as compared to 142 million cords, or 13 per cent, in the national forests, and to 6 million cords, or less than 1 per cent, in the Indian reservations. (Table 14 and Fig. 17.) States, counties, and municipalities together hold 21 million cords, or about 2 per cent of the total.

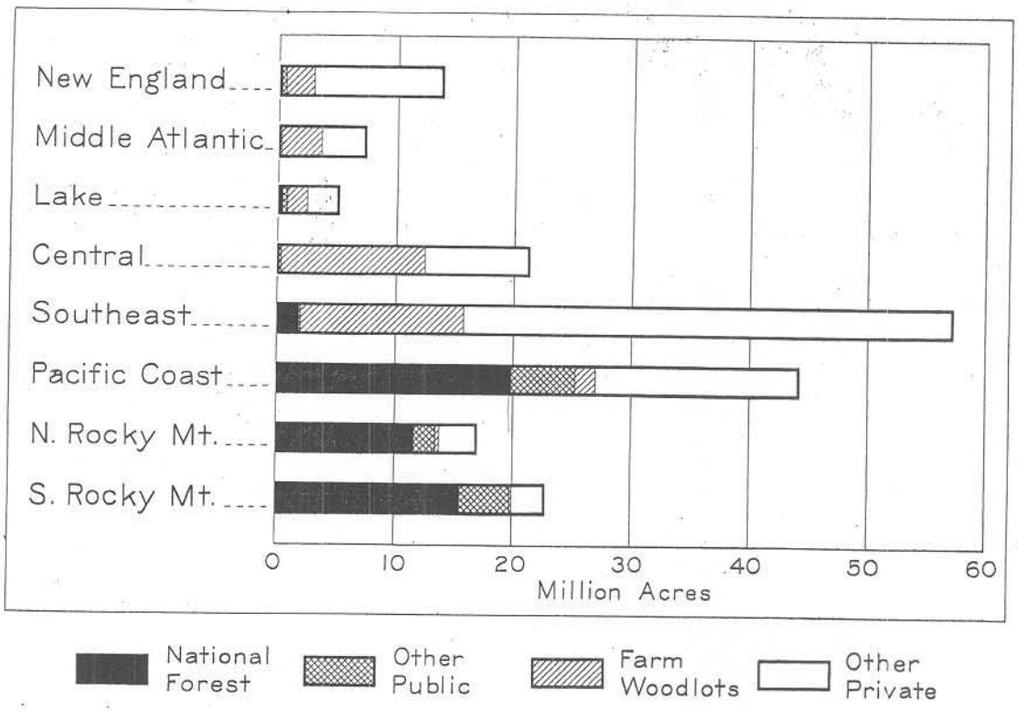

FIG. 12 - OWNERSHIP OF SAW-TIMBER AREAS BY REGIONS

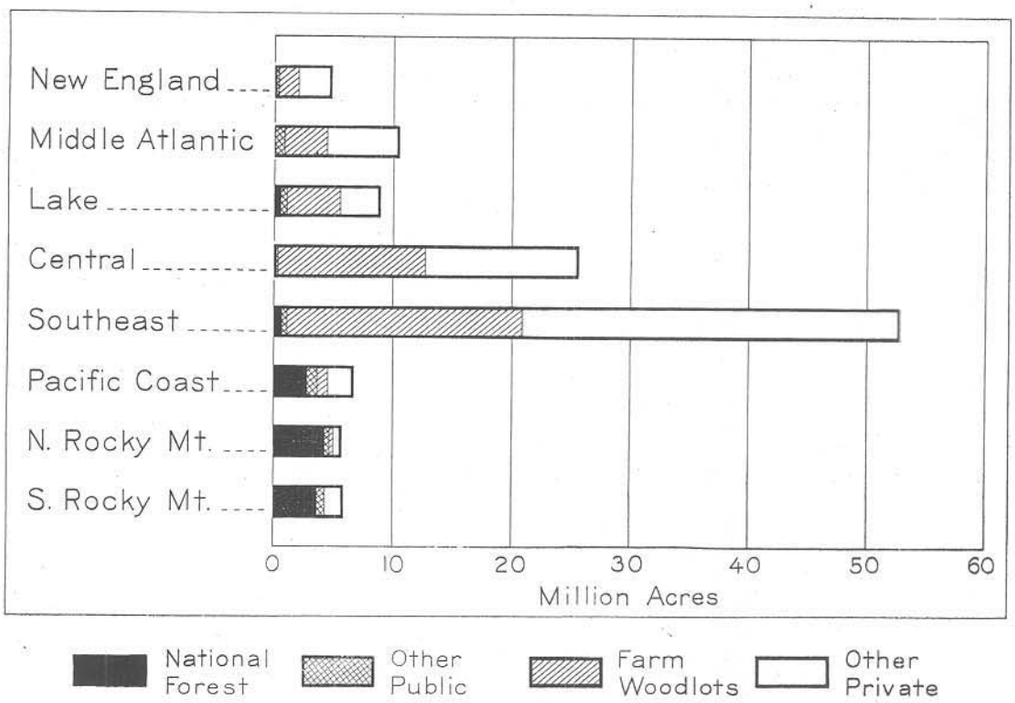

FIG. 13 - OWNERSHIP OF CORDWOOD AREAS BY REGIONS

Table 11 - Ownership of cordwood areas, by regions

Region	All areas		Federally owned or managed				State county, and municipal	Private		
			Total	National forest	Indian reservation	Other		Total	Farm woodlot	Other
	Thousand acres	Per cent	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres
New England	4,843	4	112	112	..	..	190	4,541	1,700	2,841
Middle Atlantic	10,518	9	48	40	..	8	772	9,698	3,613	6,085
Lake	8,880	7	578	510	68	..	469	7,833	4,525	3,308
Central	25,592	21	158	158	..	..	66	25,368	12,432	12,936
Southeast	52,702	44	638	631	3	4	1/ 421	51,643	19,789	31,854
Pacific Coast	6,683	5	3,476	2,755	441	280	109	3,098	928	2,170
North Rocky Mt.	5,704	5	4,550	4,296	112	142	129	1,025	309	716
South Rocky Mt.	5,959	5	4,146	3,567	222	357	127	1,686	3	1,683
Total	120,881	100	13,706	12,069	846	791	2,283	104,892	43,299	61,593

1/ Largely tax-delinquent land, the final status of which has not been determined.

Table 12 - Ownership of fair to satisfactory restocking areas, by regions

Region	All areas		Federally owned or managed				State county, and municipal	Private		
			Total	National forest	Indian reservation	Other		Total	Farm woodlot	Other
	Thousand acres	Per cent	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres	Thousand acres
New England	6,145	6	86	86	..	..	208	5,851	1,572	4,279
Middle Atlantic	5,998	6	140	131	..	9	786	5,072	1,724	3,348
Lake	28,165	28	1,206	543	651	12	2,276	24,683	4,384	20,299
Central	12,245	12	133	133	..	..	34	12,078	5,193	6,885
Southeast	37,236	36	373	366	3	4	1/ 1,711	35,152	12,084	23,068
Pacific Coast	6,190	6	1,610	1,166	104	340	256	4,324	1,119	3,205
North Rocky Mt.	5,933	6	4,226	3,935	96	195	167	1,540	407	1,133
South Rocky Mt.	161	(2/)	143	135	..	8	2	16	5	11
Total	102,073	100	7,917	6,495	854	568	5,440	88,716	26,488	62,228

1/ Largely tax-delinquent land, the final status of which has not been determined.

2/ Less than one per cent.

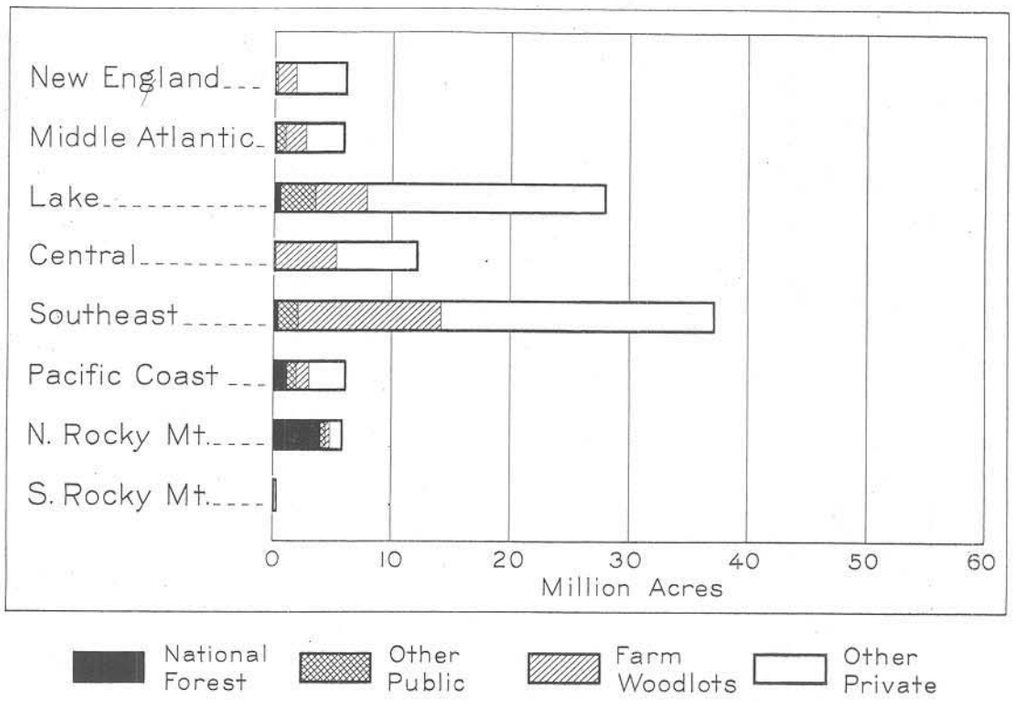

FIG. 14 - OWNERSHIP OF FAIR TO SATISFACTORY RESTOCKING AREAS BY REGIONS

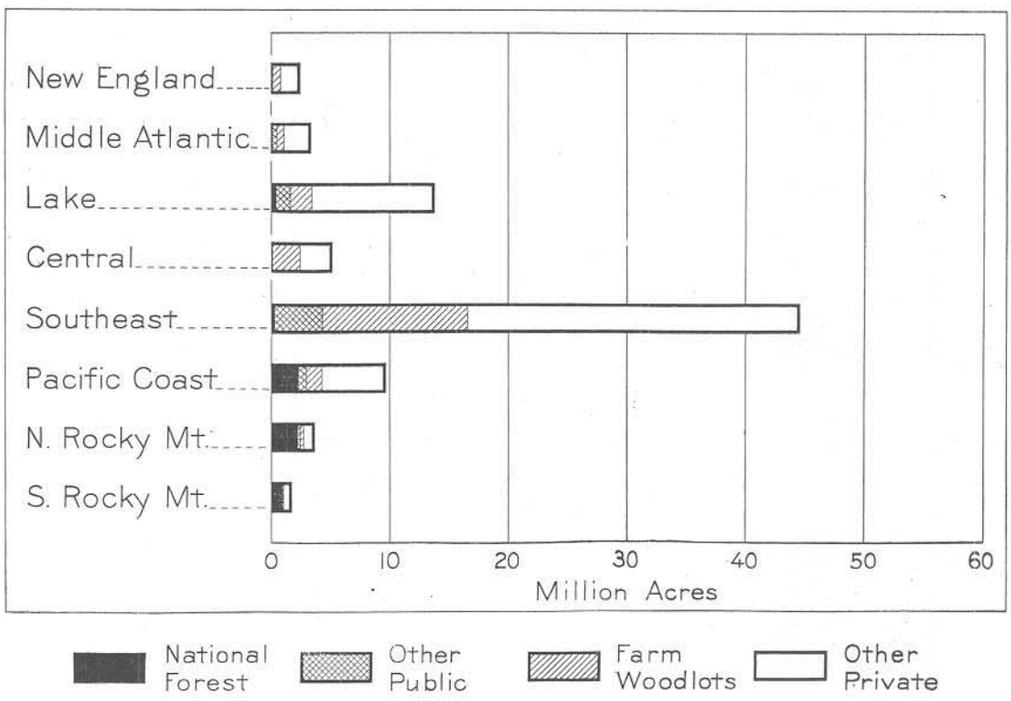

FIG. 15 - OWNERSHIP OF POOR TO NON-RESTOCKING AREAS BY REGIONS

Table 13 - Ownership of stands of saw-timber, by regions

Region	All stands		Federally owned or managed				State county, and municipal	Private		
			Total	National forest	Indian reservation	Other		Total	Farm woodlot	Other
	Million ft.b.m.	Per cent	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.
New England	57,875	3	1,119	1,119	..	..	1,363	55,393	7,972	47,421
Middle Atlantic	26,150	2	98	94	..	4	221	25,831	12,000	13,831
Lake	35,887	2	2,284	1,200	1,084	..	870	32,733	10,366	22,367
Central	34,622	2	449	444	..	5	107	34,066	17,453	16,613
Southeast	199,297	12	3,868	3,653	195	20	312	195,117	48,267	146,850
Pacific Coast	1,041,628	62	421,571	357,198	21,342	43,031	26,155	593,902	25,206	568,696
North Rocky Mt.	146,388	9	93,130	88,840	2,290	2,000	11,527	41,731	1,508	40,223
South Rocky Mt.	125,956	8	114,963	99,917	6,995	8,071	1,457	9,516	64	9,452
Total	1,867,803	100	637,502	552,465	31,906	53,131	42,012	988,289	122,836	865,453

Table 14 - Ownership of stands of cordwood on cordwood areas, by regions

Region	All stands		Federally owned or managed				State county, and municipal	Private		
			Total	National Forest	Indian reservation	Other		Total	Farm woodlot	Other
	Thousand cords	Per cent	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords
New England	56,801	5	1,253	1,253	..	..	2,098	53,450	19,605	33,845
Middle Atlantic	125,641	11	718	608	..	110	8,794	116,129	42,904	73,225
Lake	123,398	11	5,197	4,633	564	..	2,726	115,475	44,713	70,762
Central	156,338	14	743	743	..	..	353	155,242	61,310	93,932
Southeast	429,900	39	6,018	5,963	30	25	1/ 2,677	421,205	171,947	249,258
Pacific Coast	75,906	7	37,155	28,700	2,869	5,586	1,740	37,011	9,429	27,582
North Rocky Mt.	104,604	10	83,402	78,871	2,240	2,291	2,152	19,050	6,025	13,025
South Rocky Mt.	29,555	3	22,324	20,755	799	770	482	6,749	17	6,732
Total	1,102,143	100	156,810	141,526	6,502	8,782	21,022	924,311	355,950	568,361

1/ Almost entirely on tax-delinquent land, the final status of which has not been determined.

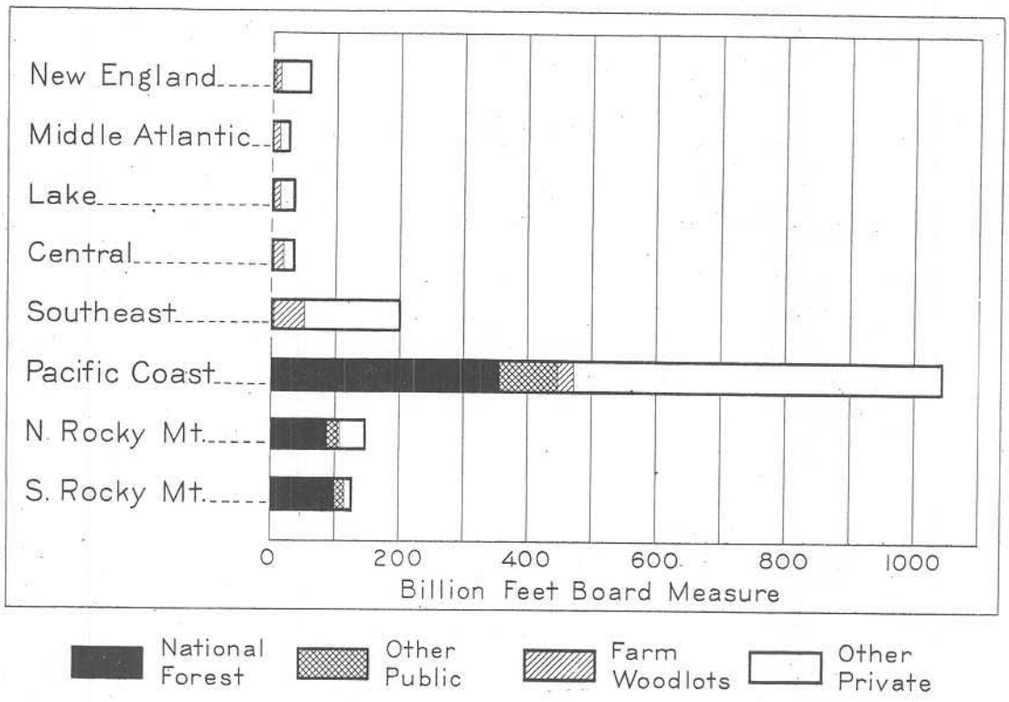

FIG.16.-OWNERSHIP OF SAW-TIMBER STAND OF THE UNITED STATES BY REGIONS

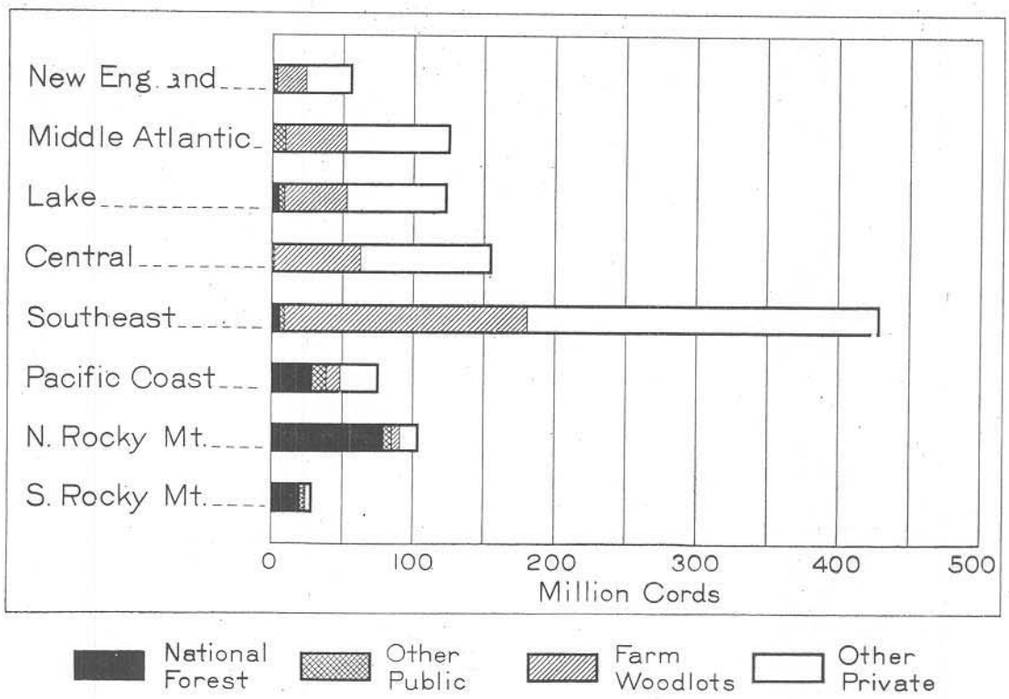

FIG.17.-OWNERSHIP OF STAND OF CORDWOOD ON CORDWOOD AREAS BY REGIONS

AVAILABILITY AND SUITABILITY OF EXISTING TIMBER

As to our existing timber supply, the statistics presented in the preceding pages do not by any means tell the whole story; in fact, they are likely to be misleading if not considered in relation to other very important factors. The long transportation distances that separate the major saw-timber forests from the large centers of population should also be taken into account. Of equal importance are the factors that make for the economical manufacture of forest products, such as the length of haul from the timber to milling facilities, the degree to which the timber is scattered, the size and character of the trees, proportion of inferior species, logging difficulties, and the like. An analysis of all the important factors indicates that existing stands do not constitute a plentiful and well-distributed supply of suitable and economically available timber.

Western Supply

It has been shown that 1,314 billion board feet of the country's total saw-timber stand of 1,668 billion board feet is in the Rocky Mountain and Pacific Coast regions. This western timber, unfortunately, is not only far removed from the large consuming centers of the East, but much of it is high up in the mountains where logging costs are excessively high. Just what proportion of the saw timber in Washington, Oregon, California, Idaho, Colorado, or in any other of the twelve western States, represents an available supply for the country generally is problematical. It depends to a large extent on how much the large and distant markets will or can afford to pay for the products of the forest; in general, it is probably true that a widespread and liberal use of wood is contingent on comparatively low prices to the ultimate consumer, or for the most part on the use of timber locally grown.

On the basis of mill lumber prices that obtained from 1925 to 1929, inclusive, only about 600 billion board feet of the western timber supply, or less than 50 per cent of the total, is available for conversion. In other words, 700 billion feet of the western saw-timber reserve had no positive realization value during the 1925-1929 period. An advance of $5.00 per thousand feet over the 1925-1929 prices would probably make 400 billion board feet additionally available, and a further advance of $5.00 or $10.00 or even more in lumber prices will be required to make all of the western saw-timber stand available for economical conversion.

The above estimate as to the availability of western timber is necessarily based on present logging and milling methods. Improvements in logging and milling practices resulting in lower costs would automatically make more of the western timber available. As the result of improvements already made, timber that could not have been logged a decade or so ago is now utilized economically. Pacific coast loggers, in fact, have overcome seemingly insurmountable difficulties; trees 4, 6, or 8 feet in diameter, standing on rough, steep ground, are now converted into logs; and the logs, some of them scaling 8,000 board feet and weighing 30 tons, are dragged with great dispatch over the ground or swung down steep slopes and over steep canyons on overhead cables.

Eastern Supply

Eastern Supply

The combined New England, Middle Atlantic, Lake and Central regions, which contain nearly 70 per cent of the population of the United States, have only about 155 billion board feet of saw timber, or less than 10 per cent of the total for the country. The old-growth stands of these four regions comprise less than 60 billion board feet; the fact that old-growth timber still remains in these regions whose industries are drawing heavily on distant timber supplies in itself indicates that the local supply is relatively inaccessible or of poor quality. The second-growth stands, which include two-thirds of the total saw-timber supply of the four regions, are in the main good for little more than common lumber. A substantial proportion of the second-growth saw timber, for one reason or another can not be utilized profitably at present. As a result of destructive logging practices in the early days, uncontrolled fire, and latterly the culling of the forest for the more desirable trees, many of the second-growth saw-timber stands are no more than scattered trees that barely meet the minimum requirements for saw logs, in mixture with badly defective trees or trees of inferior species. Not only are the merchantable trees of small size and relatively poor quality but the stands as a whole contain only a small volume of the more desirable species.

Regional Supplies and Industrial Migration

The various migrations of the wood-using industries throw considerable light on the forest situation as regards the availability and suitability of existing timber supplies. In softwood lumber manufacture, the depletion of virgin supplies has marked an industrial cycle in each region, in which local industries developed, dominated the consuming markets of the country, and declined at last so far as to be unable to meet the local requirements of the region. Each cycle has had the same essential characteristics of a change from light culling operations to clean cutting of good timber and poor alike, and shifting the cut from the more to the less desirable species. The peak of softwood lumber production moved successively from New England to New York, to Pennsylvania, and thence, to the Lake States, culminating in the Lake region in 1892 with a lumber cut of nearly 9 billion feet, which supplied the markets of the country from the Great Plains to the Atlantic Ocean and from the Canadian boundary literally to the Gulf. In their turn, southern yellow pines and Pacific Coast lumber have held the commanding position in the nation's markets, the southern pines passing a peak of 16 billion feet of lumber in 1909. For over a decade Pacific Coast timber has dominated Lake States markets and has now entered in appreciable quantities the markets of the South. In 1929, Washington, Oregon, California, and Idaho produced over 15 billion feet of softwood lumber, or about half of the total softwood lumber cut of the country in that year.

Hardwood lumber production centers have shifted in much the same way. From New England and along the Atlantic Coast the industry spread slowly westward through New York and Pennsylvania and, as water and rail transportation were developed, into Ohio and the Middle Atlantic States. From here it spread north into the Lake States and south into Kentucky and Tennessee and the southern Appalachian Mountains. The available stands of desirable hardwood of these various regions have for the most part been successively depleted. The most important hardwood reserve is in the southern Mississippi Valley.

Various industries have been seriously affected by the vanishing virgin timber supply. The modern high-grade furniture factory can change its location only at great loss of capital expenditures. As the plentiful supply of high-grade hardwoods, including black walnut, cherry, oak, birch, and maple in the Northeast became scarce, the factories moved in later years to Massachusetts, New York and Pennsylvania, southern Michigan and the lower Ohio River valley, and North Carolina. The location of an important center of furniture manufacture in North Carolina signalized a shift from waning supplies of northern hardwoods to the large supply of southern hardwoods, including southern oak and red gum. Now these factories, as well as those of the North, must obtain much of their raw material from the lower Mississippi Valley, in which is located the last substantial reserve of virgin hardwood in the United States.

The veneer industry faced much the same situation, especially in the case of high-grade veneer. The large hardwood logs practically clear of defects, from which high-grade veneers are customarily produced, can be obtained only from such trees as are found in old-growth stands. In the Northeast, however, veneer logs must now be obtained in a large measure from second-growth stands, at high cost and often very wastefully. Inevitably the industry has turned to the South for its raw material. Red gum is already being used in larger quantities than any other wood, supplying both high and low grade veneer to an extent that imposes a heavy drain on the best-quality timber of this species. Tupelo, also a southern species, stands second in importance for hardwood veneers.

The handle industry, which is very exacting in its requirements, has found no satisfactory substitute for the high-grade ash and hickory that make up three-fourths of its raw material. The dense upland ash, much preferred for handles, was formerly supplied from excellent stands in the States north of the Ohio river, but these are now largely cut out and most of the present supply must be obtained from the less satisfactory supplies in the lower Mississippi Valley region. Not only do present supplies of hickory come mainly from the South but most of the accessible timber there has been taken. More and more it is becoming necessary to work into the districts remote from transportation facilities.

The vehicle and agricultural implement industries, located mainly in the Middle West, compete for southern hickory and ash with the handle industry, and with other wood-using industries, including furniture and veneer manufacturers, for other hardwoods.

Relatively larger plant investments, together with the requirement in newsprint manufacture for abundant and cheap power, make it much more difficult for paper mills to follow the retreating timber stands than for sawmills. The pulp and paper industry has largely centered within easy transportation distance of the spruce forests of New England and New York and the spruce and hemlock forests of the Lake States. The mechanical and sulphite mills are at present practically dependent upon ample supplies of spruce and hemlock, but this development has also carried with it a considerable part of the sulphate-pulp industry which could have located elsewhere. Even the soda-pulp industry, which began and is now well developed in Pennsylvania, manufactures a large part of its product from aspen in the spruce forests.

Pulp manufacture in these regions has in general followed the lumbering operations, starting with diminished supplies of timber and reducing them still further. Fundamentally, we have imported pulpwood because our own supplies of material tributary to many of the existing mills have been reduced, while our requirements for paper, pulp, and pulpwood have been expanding. Within the past few years our pulp and paper imports (mostly from Canada) have constituted the equivalent of about 40 per cent of the wood utilized in our total paper consumption, or nearly four times the imports of pulpwood alone. In recent years a paper industry has sprung up in the Lower Mississippi region, and the industry in the Pacific Northwest has expanded. All signs now point to a marked migration of the eastern industry to the forest regions of the South and West.

PRESENT DRAIN ON FOREST

The standing timber in the United States is being cut and destroyed at the rate of more than 16 billion cubic feet per year. That of saw-timber size is being cut for lumber and other uses and destroyed by fire, disease, insects, drought, and wind at the rate of 59 billion board feet per year, or six times the growth in this type of material. Timber cut accounts for 89 per cent of the total drain on the forests, fire losses for 5 per cent, and disease, insects, drought, and wind for 6 per cent. (Table 15 and Figs. 18 and 19.)

In 1920 the Forest Service estimated the annual timber drain at 26 billion cubic feet, as compared to the present estimate of 16 billion. The difference in the two estimates is partly due to the decline in the use of wood for fuel; the fuelwood drain in 1920 was estimated at 110 million cords, as compared to the present estimate of 61 million cords. Then, too, the two estimates of timber are not on an entirely comparable basis. For example, bark was included in the 1920 estimate, whereas it is excluded from the present estimate; and the use of improved conversion factors in themselves further reduces the present estimate of timber drain. On the other hand, it should be noted that the estimated saw-timber drain for 1920 amounted to 56 billion board feet, as compared to 59 billion in the present estimate. The seeming increase in the saw-timber drain is due to differences in the methods used in making the estimate, rather than a true increase in the saw-timber drain; available information indicates that the saw-timber drain in 1920 may have been somewhat higher than at present.

Timber Cut

The United States is by far the largest consumer of wood in the world. The timber cut annually during the years 1925 to 1929, inclusive, in the forests of the United States amounts to more than 14 billion cubic feet, or about one-third of the total world consumption; although the imports of forest products into the United States are larger than exports, both are comparatively small, so that cut and consumption in the aggregate are practically equal. (Table 16.) Of saw-log timber the annual cut amounts to 11 billion cubic feet, or nearly one-half of the world's consumption of 23 billion; and in smaller trees to nearly 4 billion cubic feet, or around one-sixth of the world's consumption. The per capita timber cut of the United States is 118 cubic feet, of which 89 cubic feet (445 board feet), or 75 per cent, is saw-log timber, and 29 cubic feet, or 25 per cent, cordwood.

Table 15 - Timber removed yearly from the forests of the United States, by agencies

Agency	All timber			Saw timber			Cordwood 1/		
	T o t a l	Softwood	Hardwood	T o t a l	Softwood	Hardwood	T o t a l	Softwood	Hardwood
	M cu. ft.	M cu. ft.	M cu. ft.	M ft. b.m.	M ft. b.m.	M ft. b.m.	Cords	Cords	Cords
Timber cut 2/	14,495,308	8,683,886	5,811,422	54,641,444	40,228,682	14,412,762	35,486,179	11,141,362	24,344,817
Fire losses 3/	870,690	601,490	269,200	1,390,233	1,250,948	139,285	6,903,718	4,231,994	2,671,724
Other losses 4/	940,209	652,111	288,098	3,102,162	2,775,284	326,878	4,081,362	1,742,426	2,338,936
All agencies	16,306,207	9,937,487	6,368,720	59,133,839	44,254,914	14,878,925	46,471,259	17,115,782	29,355,477

1/ Trees of less than saw-timber size on saw-timber, cordwood, and restocking areas.

2/ Timber cut for commodity use.

3/ Timber killed by fire and not utilized.

4/ Timber killed by disease, insects, drought, wind, etc., and not utilized.

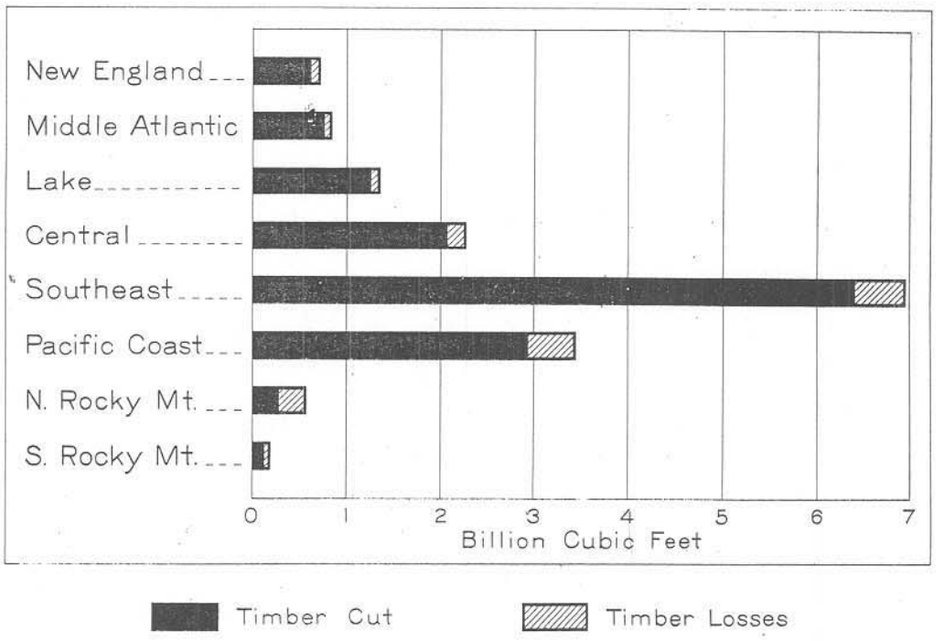

FIG. 18 — TOTAL DRAIN ON THE FORESTS OF THE UNITED STATES BY REGIONS

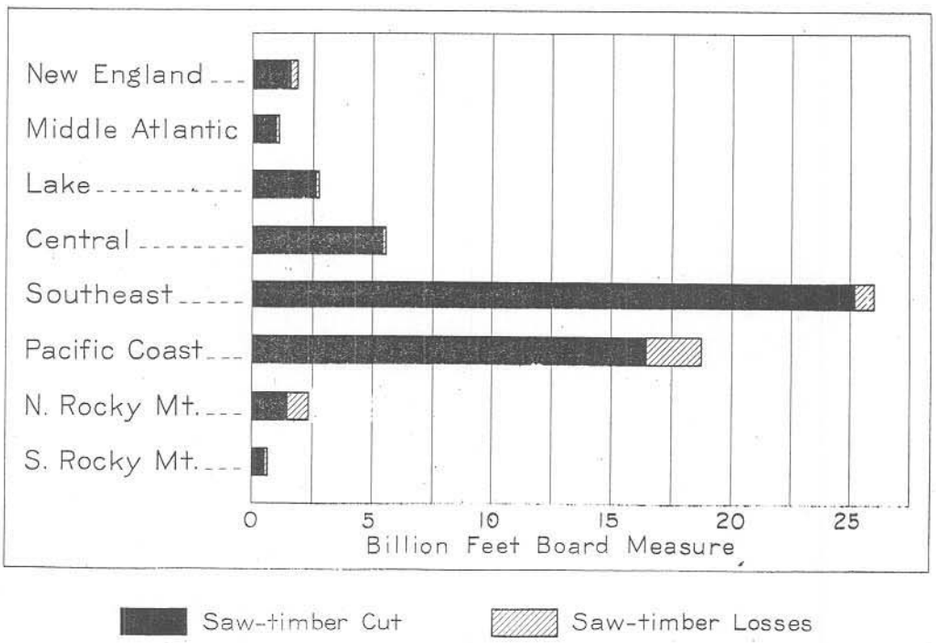

FIG. 19 — TOTAL SAW-TIMBER DRAIN ON THE FORESTS OF THE UNITED STATES BY REGIONS

Table 16 - Timber cut yearly for commodity use from forests of the United States, by commodities

Commodities produced					Timber cut								
Item	Unit	Quantity			All timber			Saw timber			Cordwood 1/		
		Total	Softwood	Hardwood	Total	Softwood	Hardwood	Total	Softwood	Hardwood	Total	Softwood	Hardwood
		Thousands	Thousands	Thousands	Thousand cu.ft.	Thousand cu.ft.	Thousand cu.ft.	Thousand ft.b.m.	Thousand ft.b.m.	Thousand ft.b.m.	Cords	Cords	Cords
Lumber	Ft. b.m. 2/	38,000,000	30,957,920	7,042,080	7,371,372	5,668,700	1,702,672	38,000,000	30,957,920	7,042,080	..	..	..
Fuelwood	Cords	61,266	22,511	38,755	4,002,635	1,485,135	2,517,500	7,047,000	4,146,000	2,901,000	27,723,840	7,291,200	20,432,640
Hewed ties	Pieces	53,215	22,078	31,137	633,034	232,491	400,543	2,025,165	835,553	1,189,612	..	..	..
Fence posts	Pieces	395,946	138,503	257,443	628,836	278,438	350,398	1,299,459	654,438	645,021	3,641,342	1,615,345	2,025,997
Pulpwood	Cords	5,336	4,726	610	588,666	521,908	66,758	1,473,620	1,316,815	156,805	2,084,080	1,827,120	256,960
Mine timbers (round)	Cu. ft.	184,875	37,509	147,366	231,780	47,530	184,250	155,988	43,626	112,362	1,692,152	325,437	1,366,715
Veneer logs	Ft. b.m. 3/	920,034	293,882	626,152	230,607	59,601	171,006	1,033,708	332,691	701,017	..	..	..
Slack staves	Pieces	979,610	360,970	618,640	109,345	33,863	75,482	487,861	179,780	308,081	..	..	..
Slack heading	Sets	67,766	43,310	24,456	42,452	24,701	17,751	203,016	129,737	73,279	..	..	..
Slack hoops	Pieces	138,939	..	138,939	10,053	..	10,053	41,626	..	41,626	..	..	..
Logs & bolts in manufactures	Ft. b.m. 3/	593,328	92,393	500,935	156,575	20,790	135,785	677,960	109,443	568,517	..	..	..
Tight staves	Pieces	307,167	149,921	157,246	97,116	39,414	57,702	460,378	224,822	235,556	..	..	..
Tight heading	Sets	26,609	9,888	16,721	43,733	13,047	30,686	199,372	74,138	125,234	..	..	..
Shingles	Pieces	6,298,100	6,298,100	..	138,558	138,558	..	629,810	629,810	..	..	..	..
Export logs and hewn timbers	Ft. b.m. 3/	307,570	289,670	17,900	60,514	55,611	4,903	340,535	320,503	20,032	..	..	..
Poles	Pieces	3,443	2,790	653	37,571	31,894	5,677	149,374	131,859	17,515	43,679	31,955	11,724
Distillation wood	Cords	1,283	434	849	36,367	4,294	32,073	88,970	11,300	77,670	204,870	22,600	182,270
Piling	Pieces	1,363	912	451	28,978	21,125	7,853	141,527	108,497	33,030	13,866	13,205	661
Tanning extract wood	Cords	418	..	418	26,173	..	26,173	118,950	..	118,950	37,600	..	37,600
Excelsior wood	Cords	179	58	121	20,943	6,786	14,157	67,125	21,750	45,375	44,750	14,500	30,250
All items					14,495,308	8,683,886	5,811,422	54,641,444	40,228,682	14,412,762	35,486,179	11,141,362	24,344,817

1/ From trees of less than saw-timber size.

2/ Lumber tally measure.

3/ Log scale measure.

Softwoods supply most of the timber cut, not only in the United States but in the entire world. Of the present consumption of wood in the world, three-fourths is from the softwood forests and about one-fifth from the temperate zone hardwood forests. Abundant softwood forests have materially aided in the development of the United States, and they must also be looked upon as our chief source of saw timber. Softwoods account for 60 per cent of our total timber cut, 74 per cent of the saw-timber cut, and nearly 82 per cent of the saw timber entering into the production of lumber. For fuelwood, hewed ties, fence posts, mine timbers, and some minor items, the hardwoods are cut in greater quantities than the softwoods.

Largely because of the comparatively large volume of timber cut in the Southeast region, 77 per cent of the total cut, 66 per cent of the saw-timber cut, and practically all of the cut from trees of less than saw-timber size is from the forests of the East. The Southeast is the leading region, with 44 per cent of the total cut, and 46 per cent of the saw-timber cut. The Pacific Coast region ranks second, with 20 per cent of the total cut and 30 per cent of the saw-timber cut. In the cut from cordwood trees, the Southeast region ranks first, with 33 per cent of the total, the Central region second, and the Lake region third. (Table 17 and Figs. 20 and 21.)

Lumber is the largest single item into which the timber cut of the country enters, accounting for about 51 per cent of the total cut and 70 per cent of the saw-timber cut. Of the 38 billion board feet of saw timber consumed annually in the production of lumber, 16,672 million board feet, or 44 per cent, is cut in the Southeast region. That cut in the Pacific Coast region amounts to 36 per cent of the total, the Central region 7 per cent, the Lake region 5 per cent, the North Rocky Mountain region 4 per cent, the New England region 2 per cent, and the Middle Atantic and South Rocky Mountain regions each 1 per cent.

The next largest item is fuel wood, which forms about 28 per cent of the total cut of the country. This may be an underestimate, as of all the important items, this is the one concerning which there is least accurate information. In most of the European countries fuel wood is derived from thinnings, tops, and other material unsuitable for saw timber, and is largely a by-product of the growing of saw-log timber. In the United States some of the fuel wood is derived from logging waste, dead trees and scattered trees not in the forest area, but the bulk of it comes from saw-log timber and from cordwood trees of which most should be left to grow into saw timber. Fuel wood is the only product that is now being grown plentifully in the forests of the United States. Under rational forest practice, its production could be made a means of improving the stand, through thinnings and utilization of inferior species and poorly formed or unthrifty trees.

Of the 54,640 million board feet of saw timber cut annually from our forests, 7,047 million board feet, or 13 per cent, is cut especially for fuel wood. The Southeast region accounts for 61 per cent of the total saw timber cut for fuel, the Central region 25 per cent, and the Pacific Coast region 13 per cent. The Middle Atlantic, New England, North Rocky Mountain, South Rocky Mountain, and Lake regions together cut only 1 per cent. The cubic foot relationships are brought out in Figure 23.

Table 17 - Timber cut yearly for commodity use from the forests of the United States, by regions

Region	All timber				Saw timber				Cordwood 1/			
	Total		Softwood	Hardwood	Total		Softwood	Hardwood	Total		Softwood	Hardwood
	M cu. ft.	Per cent	M cu. ft.	M cu. ft.	M ft. b.m.	Per cent	M ft. b.m.	M ft. b.m.	Cords	Per cent	Cords	Cords
Eastern regions												
New England	619,147	4	293,503	325,644	1,647,827	3	1,284,467	363,360	2,722,673	8	191,934	2,530,739
Middle Atlantic	771,592	6	131,618	639,974	1,061,559	2	348,798	712,761	5,436,526	15	576,039	4,860,487
Lake	1,266,825	9	469,049	797,776	2,708,807	5	1,321,233	1,387,574	6,273,311	18	1,676,205	4,597,106
Central	2,066,846	14	239,387	1,827,459	5,453,791	10	980,500	4,473,291	8,628,934	24	465,105	8,163,829
Southeast	6,417,934	44	4,214,926	2,203,008	25,232,821	46	17,808,643	7,424,178	11,827,417	33	7,703,364	4,124,053
Total	11,142,344	77	5,348,483	5,793,861	36,104,805	66	21,743,641	14,361,164	34,888,861	98	10,612,647	24,276,214
Western regions												
Pacific Coast	2,937,390	20	2,920,492	16,898	16,486,839	30	16,437,668	49,171	307,172	1	239,806	67,366
North Rocky Mt.	287,190	2	287,109	81	1,510,140	3	1,509,770	370	133,983	2/	133,983	..
South Rocky Mt.	128,384	1	127,802	582	539,660	1	537,603	2,057	156,163	1	154,926	1,237
Total	3,352,964	23	3,335,403	17,561	18,536,639	34	18,485,041	51,598	597,318	2	528,715	68,603
All regions	14,495,308	100	8,683,886	5,811,422	54,641,444	100	40,228,682	14,412,762	35,486,179	100	11,141,362	24,344,817

1/ From trees of less than saw-timber size.

2/ Less than one per cent.

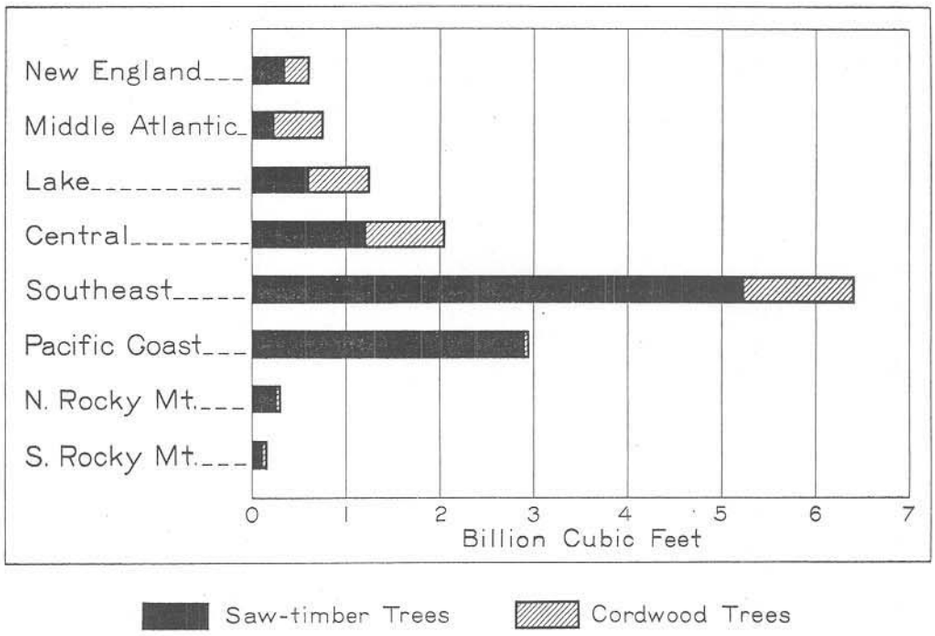

FIG. 20 – TOTAL CUT ON THE FORESTS OF THE UNITED STATES BY TREE SIZE AND REGION

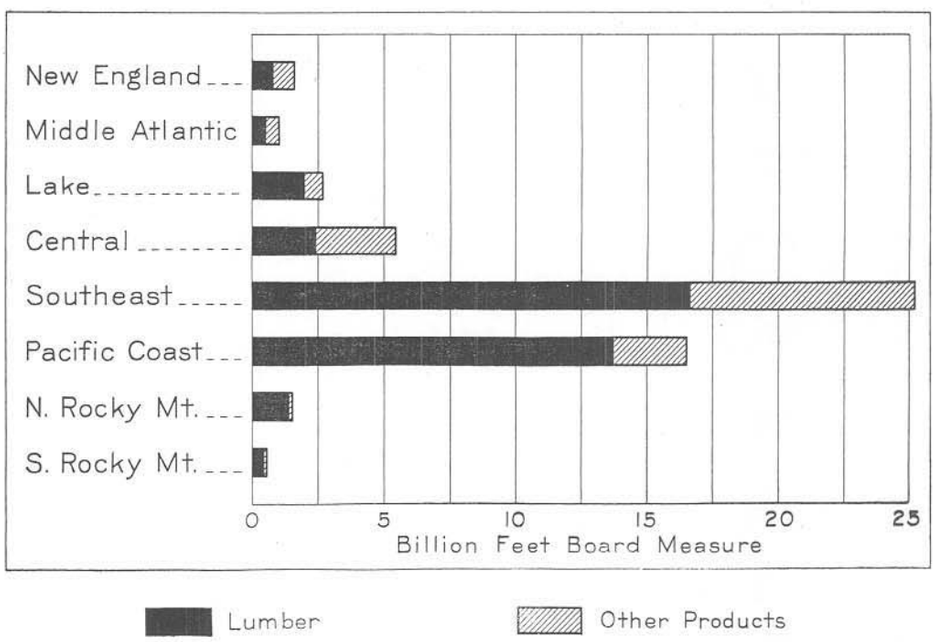

FIG. 21 – TOTAL SAW-TIMBER CUT ON THE FORESTS OF THE UNITED STATES BY USE AND REGION

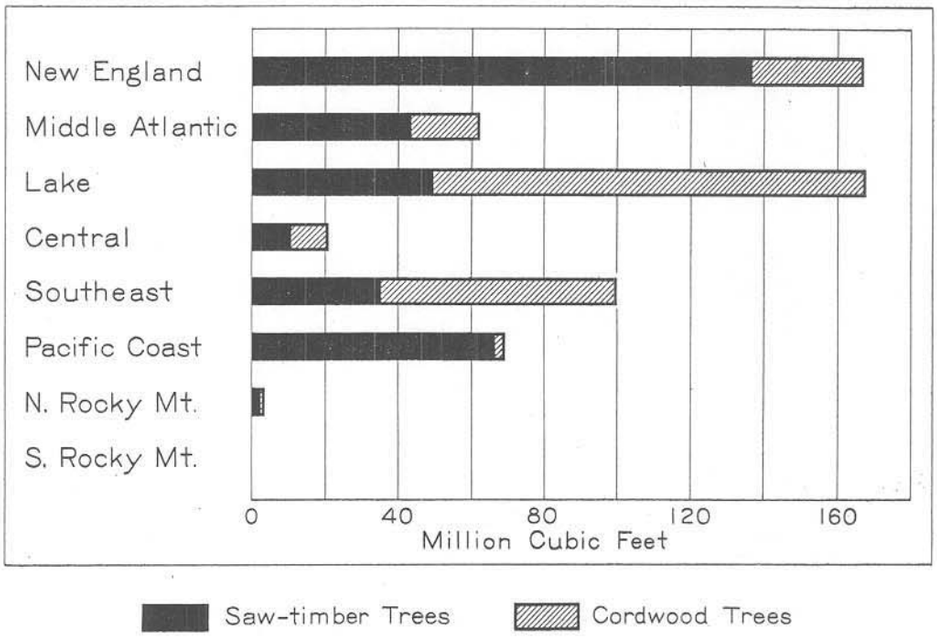

FIG. 22 — TOTAL CUT FOR PULPWOOD ON THE FORESTS OF THE UNITED STATES BY TREE SIZE AND REGION

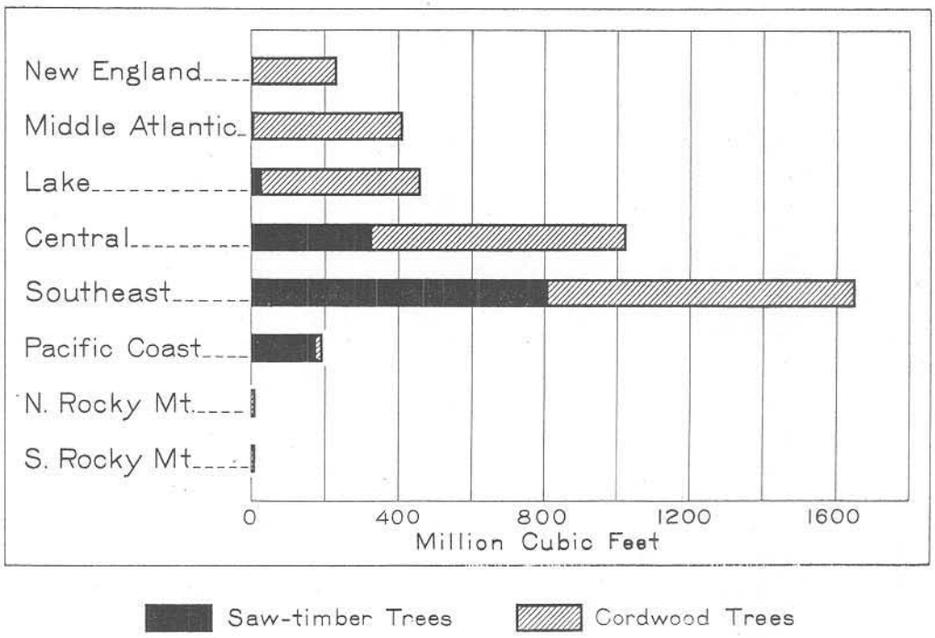

FIG. 23 — TOTAL CUT FOR FUEL-WOOD ON THE FORESTS OF THE UNITED STATES BY TREE SIZE AND REGION

In quantity of timber consumed, the hewed tie ranks third. In the production of this product 2,025 million board feet of saw timber are consumed annually, 1,190 million of hardwood and 835 million of softwood. That cut in the Southeast region amounts to 63 per cent of the total, the Central region 19 per cent, the Lake region 10 per cent, the South Rocky Mountain region 3 per cent, the Pacific Coast region 2 per cent, and the Middle Atlantic, North Rocky Mountain, and New England regions each 1 per cent.

The total quantity of wood consumed annually in the production of round and split fence posts amounts to 629 million cubic feet, or little less than that for hewed ties. This item could be obtained, more largely, as in fuel wood, from thinnings, tops of trees, and other low-grade material, and yet at present it comes mostly from saw timber or from young, thrifty trees that are cut prematurely, thereby contributing to the depletion of the saw-timber stand. Table 16 shows that 1,300 million board feet of saw-timber trees and 3,640 thousand cords of smaller trees are cut each year solely for the production of round and split posts.

Nearly 1½ billion board feet of saw-timber trees and over 2 million cords of smaller trees are cut annually from our forests for pulpwood. Of the total of nearly 600 million cubic feet, that cut from the forests of the Lake region amounts to 28 per cent, the New England region 28 per cent, the Southeast region 17 per cent, the Pacific Coast region 12 per cent, the Middle Atlantic region 11 per cent, and the Central region 4 per cent. (Figure 22.)

Round and split mine timbers, veneer and export logs, cooperage, shingles, hewn timbers, poles, piling, distillation, tanning, and excelsior wood, etc., make up 9 per cent, or 4,796 million of the 54,640 million board feet of saw timber cut annually in the United States.

Timber Losses

Forest losses resulting from forest fires, insects, disease, drought, and wind amount to nearly 2 billion cubic feet per year; about 4½ billion board feet in saw-timber trees and about 11 million cords in cordwood trees. (Table 15.) This does not include the normal loss which occurs through the death and decay of individual trees, but only large-scale destruction. Much of this loss is caused by fires that might have been prevented or checked, and by epidemics of insects and disease, the ravages of which in many instances could have been greatly modified under a more effective system of forest management.

Forest Fires

Timber killed annually by fire and not utilized during the years 1925 to 1929, inclusive, amounted to over 870 million cubic feet, including nearly 430 million on saw-timber areas and over 440 million on cordwood and restocking areas. Fire losses in trees of saw-timber size amounted to nearly 1,400 million board feet, and in trees of cordwood size to nearly 7 million cords. (Table 18.)

These losses do not include the destruction of young growing stock, which represents a far more formidable loss. Nor do they include the damage done to larger trees that survived. Fire, which goes hand in hand with destructive methods of

Table 18 - Timber loss resulting each year from fire, in timber killed and not utilized, by type of growth and region

Region	All timber			Saw timber			Cordwood 1/		
	T o t a l	Softwood	Hardwood	T o t a l	Softwood	Hardwood	T o t a l	Softwood	Hardwood
	M cu. ft.	M cu. ft.	M cu. ft.	M ft. b.m.	M ft. b.m.	M ft. b.m.	Cords	Cords	Cords
New England	14,515	4,041	10,474	2,370	834	1,536	149,963	40,621	109,342
Middle Atlantic	52,111	13,463	38,648	7,171	1,822	5,349	561,327	144,622	416,705
Lake	63,011	20,201	42,810	3,740	895	2,845	782,734	221,224	561,510
Central	87,153	8,007	79,146	12,050	985	11,065	937,777	85,873	851,904
Southeast	294,756	196,634	98,122	395,314	276,824	118,490	2,373,504	1,641,241	732,263
Pacific Coast	182,022	182,022	..	563,549	563,549	..	902,822	902,822	..
North Rocky Mt.	172,829	172,829	..	392,944	392,944	..	1,177,243	1,177,243	..
South Rocky Mt.	4,293	4,293	..	13,095	13,095	..	18,348	18,348	..
Total	870,690	601,490	269,200	1,390,233	1,250,948	139,285	6,903,718	4,231,994	2,671,724

Table 19 - Abnormal timber loss resulting each year from disease, insects, wind, etc., in trees killed and not utilized, by type of growth and region

Region	All timber			Saw timber			Cordwood 1/		
	T o t a l	Softwood	Hardwood	T o t a l	Softwood	Hardwood.	T o t a l	Softwood	Hardwood
	M cu. ft.	M cu. ft.	M cu. ft.	M ft. b.m.	M ft. b.m.	M ft. b.m.	Cords	Cords	Cords
New England	72,348	65,113	7,235	254,600	229,140	25,460	247,820	223,032	24,788
Middle Atlantic	11,374	..	11,374	14,155	..	14,155	91,244	..	91,244
Lake	13,524	3,530	9,994	35,263	6,849	28,414	54,634	12,414	42,220
Central	109,088	2,916	106,172	59,248	1,452	57,796	1,072,164	28,713	1,043,451
Southeast	253,899	100,576	153,323	411,126	210,073	201,053	1,899,083	761,850	1,137,233
Pacific Coast	324,599	324,599	..	1,748,664	1,748,664	..	371,711	371,711	..
North Rocky Mt.	106,309	106,309	..	474,550	474,550	..	94,910	94,910	..
South Rocky Mt.	49,068	49,068	..	104,556	104,556	..	249,796	249,796	..
Total	940,209	652,111	288,098	3,102,162	2,775,284	326,878	4,081,362	1,742,426	2,338,936

1/ Includes trees of less than saw-timber size on saw-timber, cordwood, and restocking areas.

logging, has, through repeated burning of young trees and complete destruction of saplings and seedlings, been responsible primarily for the lowered productivity of immense areas of forest land, and has been the chief means of keeping the forest growth of the United States below the current drain upon our timber.

During the years 1925 to 1929, inclusive, the number of forest fires averaged 129,000 per year; and the area of forest land in public and private ownership burned over annually amounted to about 45 million acres, or about 9 per cent of the total forest area of the United States. (Table 20.) It is noteworthy that of the total average area burned over annually, over 41 million, or 90 per cent, was in the Southeast region, also that half of the area burned over in the Southeast region was in two States.

The fires burned over extensive areas in all four general types of forest cover, but in varying degree. In the saw-timber areas 5.3 per cent was burned over, in the cordwood areas 9.7 per cent, in the restocking area 11.5 per cent, and in the non-restocking area 17.2 per cent. This is in line with what would be expected; not only is better protection given to the older and more valuable timber, but fires as a rule are more likely to spring up and race through young stands. (Table 20.)

Although these data are necessarily approximations, since they include a figure for unprotected land which can only be estimated, they give a basis for certain important conclusions. The great bulk of forest-fire damage, in terms of acres burned over, occurs on lands which have not been placed under organized fire protection, amounting during the calendar year 1930 to about 90 per cent of the total area burned over. In the entire protected area the acreage burned in 1930 was 1.44 per cent of the total, whereas the corresponding figure for the unprotected area was about 20 per cent. These figures alone show that forest fires can be controlled.

It should be stated, in this general connection, that about 80 per cent of the present unprotected forest area lies in the Southeast. In this region, organized fire protection is comparatively new. Four of the eleven States started their protective work in 1915, six as late as 1924, and one of them is only now on the verge of establishing organized fire protection. Even in the Southeast, however, the proportion burned in the protected area in 1930 was but 4 per cent, in contrast to 30 per cent for the unprotected area.

If the present tremendous fire losses in the United States are to be reduced to a reasonable limit, attention must be concentrated on the problem of extending at least the present standard protective measures to an area of about 190 million acres now unprotected. Indications are that doubling the present effort towards organized fire protection on privately owned forest land might be sufficient to reduce fire losses to a satisfactory minimum, since it is on these lands that most of the unprotected areas are found.

That real progress has been made in extending organized protection to forest areas in private ownership during the last 20 years is shown by Figure 24. This is the period during which the Federal Government has been cooperating with the States in the protection of State and private forest land from fire under the terms, first, of the Weeks Law, and later of the Clarke-McNary Law. The 61 million acres that con-

Table 20 - Areas of forest land burned over annually in each type of forest cover, by regions, with their percentages of the total area of each type

Region	Total		Saw-timber areas		Cordwood areas		Restocking areas		Non-restocking areas	
	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent	Acres	Per cent
New England	58,100	.2	8,600	.1	15,900	.3	31,600	.4	2,000	.4
Middle Atlantic	209,800	.8	18,300	.3	72,600	.7	101,200	1.4	17,700	1.0
Lake	597,800	1.1	3,200	.1	16,600	.2	235,500	.7	342,500	4.9
Central	2,331,800	3.6	401,600	1.9	1,005,200	3.9	833,400	5.4	91,600	4.5
Southeast	41,196,100	21.5	9,347,800	16.3	10,549,100	20.0	15,999,700	23.9	5,299,500	35.9
Pacific Coast	559,100	.8	214,400	.5	39,900	.6	80,700	.7	224,100	4.4
North Rocky Mt.	189,300	.6	80,000	.5	19,800	.3	56,900	.8	32,600	1.5
South Rocky Mt.	16,000	1/	15,460	1/	540	1/	..	..	..	..
Total	45,158,000	9.1	10,089,360	5.3	11,719,640	9.7	17,339,000	11.5	6,010,000	17.2

1/ Less than one-tenth of one per cent

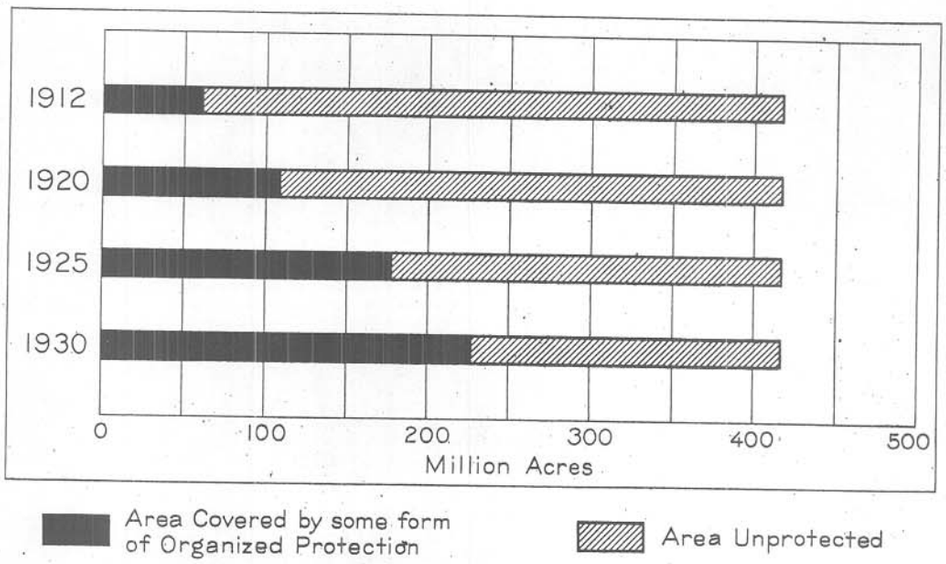

FIG. 24 - PROGRESS IN PROTECTION OF STATE AND PRIVATE FOREST LAND FROM FIRE ON BASIS OF AREA

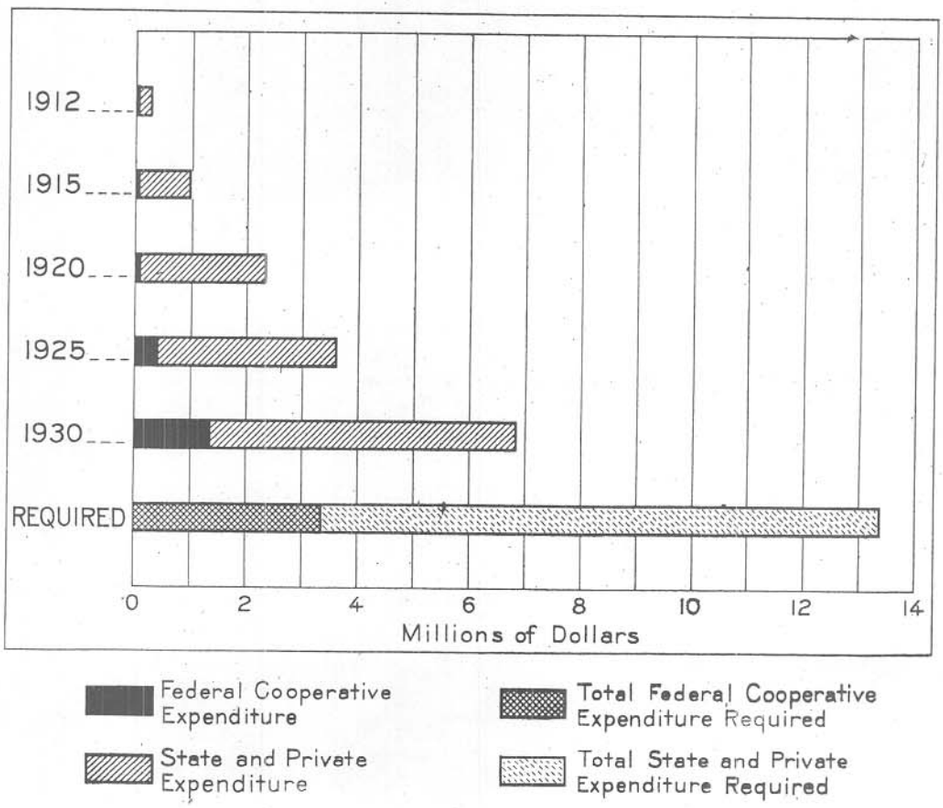

FIG. 25 - PROGRESS IN PROTECTION OF STATE AND PRIVATE FOREST LAND FROM FIRE ON BASIS OF EXPENDITURE, AND ESTIMATED EXPENDITURE REQUIRED FOR ADEQUATE PROTECTION

stituted all that was under protection as recently as 1912 grew to 227 million acres by 1930. This is encouraging; but the 190 million acres of State and private forest land still in need of similar protection demands a greatly accelerated expansion in State programs and also in the Federal program of cooperation, if the fire problem is to be met satisfactorily.

The discussion of fire protection needs would not be complete without at least a brief statement of the financial aspects. Figure 25 shows the progress in expenditure for cooperative protection, from $288,000 in 1912 to $6,859,000 in 1930. The total necessary for adequate protection is estimated to be $13,367,500. Today, generally speaking, the national, State, county and municipal forests, national parks, and Indian reservations are under well-organized protection. National and State holdings are protected mainly by direct public appropriation; private forest lands by State and private agencies in cooperation with each other and with the Federal government under the terms of the Clarke-McNary Law. The States raise their protection funds in many different ways, varying from direct State appropriations, a method used by the largest number, to direct levy upon the property within a protection district. In some States severance or privilege taxes are levied, and in a substantial number of others funds are obtained from the owners of forest land under some form of compulsory patrol legislation.

Insects, Disease, Wind and Drought

Timber killed annually by disease, insects, wind, and drought and not utilized during the years 1920 to 1929, inclusive, amounted to over 940 million cubic feet, including 700 million on saw-timber areas and 240 million on cordwood areas. Losses in trees of saw-timber size amounted to over three billion board feet, and in trees of cordwood size to over four million cords. (Table 19.)

Against the varied causes of these losses science is waging relentless warfare. Forest entomologists have made notable progress during the past 30 years in determining the life history of forest insects, in devising methods of checking their depredations, and in meeting emergencies by educational work and systematic control measures. Similarly, forest pathologists have made notable progress against the inroads of disease. Such activities have involved the study of fungus attacks; of the "infantile" diseases that are a large factor in the destruction of seedling trees; of the girdling, canker diseases, root rots, etc., to which trees of all ages are subject; as well as of the heart rots which rapidly reduce the timber content of the trees after maturity. Marked success has been obtained in controlling the diseases of forest-tree seedlings in nurseries. Age limits beyond which a stand of trees can not be profitably held because of the serious development of decay have been determined for several tree species.

TIMBER REQUIREMENTS FOR COMMODITY USE

Introduction

Beyond their function in furnishing the raw material for commodity requirements, as represented by lumber, pulpwood, ties, and so forth, forests possess huge values in social and economic benefits that are not so readily appraised in dollars and cents. The opportunities afforded by well-timbered areas for recreation, preservation of wild life, regulation of stream flow, control of erosion, and protection of city water supplies, and as a potential economic foundation for communities thriving on forest industries, represent values to the country at large that are often far greater than the more readily estimated commercial timber values. Also, in the relation of forests to the problem of effective land utilization, there is further implication of great values in national welfare. These broader non-commercial requirements can by no means be overlooked in any thoroughgoing consideration of this country's dependence upon its timber resources. The fact that they do not enter into the present treatment of commercial demands upon the forests should in no way belittle their far-reaching and lasting significance in the reader's concept of timber requirements.

Consumption as a Measure of Commodity Requirements

Timber consumption is the only practical measure of timber commodity requirements for any general discussion of the subject and is so employed here. Any attempt at an absolute measure of requirements would require the elimination of such influences as local abundance or scarcity of resources, or regional or national wealth - a refinement that would be practically impossible under present conditions. Timber requirements can hardly be assayed at the bare allowance necessary for ordinary subsistence. Where timber is abundant and easily accessible, "requirements" inevitably absorb a far greater quantity of this cheap and adaptable raw material than would come into demand under other circumstances; competition by other materials is reduced to a negligible point; "substitution" runs in the other direction and requirements over uses for wood as a substitute for other more costly and less readily accessible materials. On the other hand, timber requirements where wood is scarce and hard to get are correspondingly less than what might be termed normal use. The community or region may not consciously demand more wood and may yet be affected in a number of ways by a lack of an abundant supply of wood in place, which it might well have under a more intensive forest practice.

Past and Present in Relation to Future Requirements

Obviously it is impossible to attempt any fixed or definite estimate of future timber requirements on the basis of the statistical record of timber consumption here presented. The problem of indicating our future needs as definitely as possible can not, however, be avoided, and past experience is what we must go by. The main difficulty lies in the fact that the same consumption trends may not continue in the future as in the past. However, insofar as we can show not only what past trends have been, but the reasons for them, we at least can reduce the probable error in anticipating future trends based on these records. The present analysis has been made with that end particularly in view.

This analysis of consumption records has necessarily been focused on trends of the more important industrial products - lumber, pulpwood, and ties. Lumber, which includes not only material for construction but also for boxes, furniture, vehicles, railroad cars, woodenware, toys, and other factory products, represents by far the largest industrial consumption of timber, and is of the greatest present concern. Pulpwood is far below lumber in importance if gauged by quantity of timber consumed, but not if gauged by value of products and the part that pulp products play in our type of civilization. Railroad ties are important both as to quantity of timber consumed and service rendered, and information available permits of analysis comparable to that for lumber and pulpwood.

Analysis of these products is carried only to 1929, - first, because later data are at present inadequate, and second, because the present depression ,which overshadows completely all factors in commodity consumption since 1929, renders the later years abnormal. The true significance of this general depression must, however, be recognized before it is possible to consider consumption trends fairly. The present low consumption, as a phase of the depression, is a general condition and does not in itself indicate a permanent change for one commodity any more than for another. For instance, the decline of over 50 per cent in lumber consumption since 1929 should not be confused with the declining trend since 1906. Other manufactures have experienced abnormal declines since 1929, and there seems no reason for assuming that lumber products will not recover from the effects of the depression along with general recovery, to maintain their normal relation to all commodities.

Present Consumption and Future Requirements

Table 21, presenting figures for total production, exports, and imports of lumber, and the resultant estimates of lumber consumption, from 1809 to 1930, shows consistently that exports and imports have come close to striking a balance, and that the gap between production and consumption was less than a billion feet in most years. Foreign trade that affects by less than 3 per cent the volume of domestic production is of less relative importance in the present analysis than are some other factors. Of far greater interest in this table is the trend in lumber consumption, as shown both in total volume and per capita.

Analysis of Lumber Consumption Trends

Total and per capita lumber consumption trends since 1899 are shown in Figure 26 in relation to the trend for all manufactures and the population curve. The decline in total lumber consumption from a maximum of approximately 45 billion board feet in 1906 reached what appears to be a fairly normal low of 34 billion in 1929. The subsequent more precipitous drop registers the temporary effect of the general depression already discussed. Per capita consumption climbed from 435 board feet in 1889 to a maximum of 525 board feet in 1906 and then declined to a low of 277 feet in 1929. The present figure may be as low as 210 board feet. In view of the fluctuations evident in Figure 26, which fail to express for any one or two years what may be termed the normal trend, per capita consumption can be expressed more soundly on the basis of 10-year averages, as follows:

1889 to 1899	450	board feet
1899 to 1909	485	" "
1909 to 1919	400	" "
1919 to 1929	315	" "

Table 21 - Lumber production, exports and imports, and consumption, specified years, 1809-1929

Year	Production 1/			Exports 2/	Imports 2/	Changes in mill stocks	Visible consumption	Per capita consumption (rounded)
	Softwood	Hardwood	Total					
	M ft.b.m.	M ft.b.m.	M ft.b.m.	M ft.b.m.	M ft.b.m.	M ft.b.m.	M ft.b.m.	Ft.b.m.
1809	..	..	400,000	..	..	..	400,000	55
1819	..	..	550,000	..	..	..	550,000	55
1829	..	..	850,000	..	..	..	850,000	65
1839	..	..	1,604,000	..	..	..	1,604,000	95
1849	..	..	5,392,000	..	..	..	5,392,000	235
1859	..	..	8,029,000	..	..	..	8,029,000	260
1869	..	..	12,755,543	134,370	332,692	..	12,953,865	340
1879	..	..	18,091,356	275,102	355,304	..	18,171,558	365
1889	..	..	27,038,757	571,075	648,174	..	27,115,856	435
1899	26,371,336	8,706,259	35,077,595	1,004,464	423,928	..	34,497,059	460
1904	32,538,000	10,462,000	43,000,000	2,156,581	746,556	..	41,589,975	505
1905	32,960,000	10,540,000	43,500,000	2,012,049	938,001	..	42,425,952	505
1906	34,900,000	11,100,000	46,000,000	2,317,477	1,178,701	..	44,861,224	525
1907	34,946,000	11,054,000	46,000,000	2,501,486	1,056,965	..	44,555,479	510
1908	31,945,000	10,055,000	42,000,000	2,064,748	894,877	..	40,830,129	460
1909	33,896,959	10,612,802	44,509,761	2,293,242	1,083,018	..	43,299,537	475
1910	34,029,000	10,471,000	44,500,000	2,652,197	1,117,504	..	42,965,307	465
1911	33,020,000	9,980,000	43,000,000	3,009,434	925,488	..	40,916,054	435
1912	34,695,000	10,305,000	45,000,000	3,038,173	1,084,720	..	43,046,547	455
1913	34,065,000	9,935,000	44,000,000	3,293,037	1,031,016	..	41,719,979	430
1914	31,481,000	9,019,000	40,500,000	2,294,475	949,136	..	39,154,661	400
1915	29,655,000	8,345,000	38,000,000	1,526,618	1,096,287	..	37,569,669	380
1916	31,344,000	8,656,000	40,000,000	1,571,545	1,265,561	..	39,694,016	395
1917	28,325,000	7,675,000	36,000,000	1,346,519	1,234,447	..	35,887,928	350
1918	25,277,000	6,723,000	32,000,000	1,233,706	1,246,712	..	32,013,006	310
1919	27,407,130	7,144,946	34,552,076	1,677,843	1,190,845	..	34,065,078	325
1920	27,610,000	7,390,000	35,000,000	1,916,166	1,416,175	..	34,500,009	325
1921	23,444,000	5,556,000	29,000,000	1,511,396	902,216	..	28,390,820	260
1922	28,922,000	6,328,000	35,250,000	1,960,639	1,563,211	..	34,852,572	315
1923	33,220,000	7,780,000	41,000,000	2,472,352	1,993,327	- 798,000	39,722,975	355
1924	31,549,000	7,951,000	39,500,000	2,712,501	1,766,068	+ 247,000	38,800,562	345
1925	33,284,000	7,716,000	41,000,000	2,648,023	1,875,101	- 774,000	39,453,078	345
1926	32,078,000	7,672,000	39,750,000	2,870,145	1,932,862	+ 391,000	39,203,717	335
1927	29,975,000	7,275,000	37,250,000	3,181,590	1,781,116	- 425,000	35,424,526	300
1928	29,852,000	6,898,000	36,750,000	3,382,281	1,493,448	+ 1,718,000	36,579,167	305
1929	29,813,345	7,072,687	36,886,032	3,364,470	1,570,082	- 1,411,000	33,680,644	275

Forest Service compilation.

1/ Estimated production, except in 1869, 1879, 1889, 1899, 1909, 1919, and 1929 which show reported figures of the Bureau of the Census. Total quantities, 1920 to 1928 inclusive are as computed by the Federal Reserve Board, 1931. All other totals and all the softwood and hardwood quantities are Forest Service estimates except in the Census years specified.

2/ Compiled from Foreign and Domestic Commerce of the United States. The quantities shown for 1869 to 1899 inclusive are as quoted in Defebaugh's "History of the Lumber Industry," Vol. I.

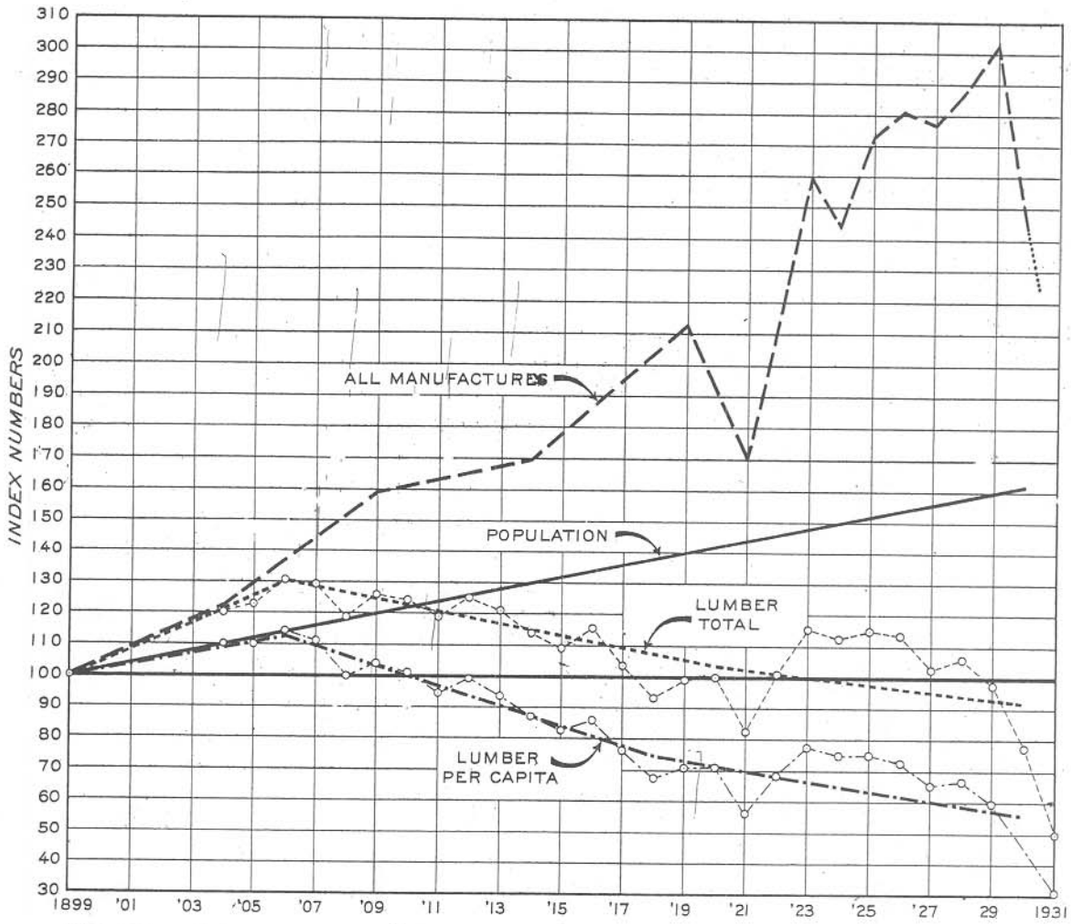

FIG. 26 – LUMBER CONSUMPTION TRENDS, COMPARED WITH TRENDS OF ALL MANUFACTURES AND POPULATION

The fact that statistics are inadequate to show the extent of the decline in specific uses of lumber products makes it difficult to determine definitely where this decline in consumption has taken place. It is first of all necessary to make up a tentative distribution of national lumber consumption and then to see how well the available data and the deductions that may be made from them sustain the estimates. Such a tentative distribution is given in Table 22,1/ for the years 1912 and 1928. These years were chosen as presenting the best data for comparable years before and after the World War. Furthermore, they practically delimit the entire curve of declining consumption prior to the present depression.

Factory products held practically the same place in the 1928 distribution as in the 1912, and differed only 8 per cent in lumber consumed. The percentage of lumber estimated as going to construction in 1928 (72 per cent) is only slightly less than that in 1912, but the actual difference of 5.6 billion feet is considerable. When this total is analyzed, and the gain in sash, door, and millwork is set aside, it is found that direct to construction accounts for all but 100 million of the loss in all lumber between these two years. The decline in direct to construction products might suggest a falling off in building, were it not for the gain of 32 per cent in sash, door, and blinds, which can only be explained by an increase in building construction. As a matter of fact, the period of 1919 to 1929 witnessed a boom in construction. Not only did this industry reach a peak, but industrial output generally and consumption of goods generally were at a maximum. This would suggest that a lumber consumption for 1928 larger than that of 1912 might have been expected. If lumber had followed general trends, 1928 should have seen a per capita consumption at least equal to 1912, and on that basis total consumption for 1928 would have been 54 billion board feet.

Construction trends must be looked to not only to explain why lumber consumption for 1928 did not exceed that for 1912, in line with consumption of other commodities, but also to account for practically the total net decline in lumber consumption from 1912 to 1928.

Construction, particularly as regards the use of lumber, can be separated into rural and urban construction. The first is subjected only to individual choice of the builder, whereas the second is subjected to various restrictions and regulations such as city building codes and zoning ordinances. Urban construction can be further divided into residential and non-residential as representing distinct types of construction.

Table 23 presents a tentative distribution of lumber consumption between the different types of construction.

Rural Building Construction

The most important factors in rural construction have been, first, a change in normal agricultural requirements, and second, agricultural depression.

1/ This distribuion is based on reports of the Forest Service, of the National Lumber Manufacturers Association, and of the Census

Table 22 - Tentative distribution of national lumber consumption for 1912 and 1928

Class of use	1912		1928		Gain or loss	
	Million ft.b.m.	Per cent	Million ft.b.m.	Per cent	Million ft.b.m.	Per cent
Factory	11,200	26	10,300	28	- 900	- 8
Construction						
Sash, door, and millwork	2,500	6	3,300	9	+ 800	+32
Direct to construction	29,300	68	22,900	63	-6,400	-22
All lumber	43,000	100	36,500	100	-6,500	-15

Changes in Normal Requirements

Change in normal rural requirements is perhaps best explained by the passing or slowing down of agricultural expansion. Number of farms has remained almost stationary for the last two decades, whereas during the previous two decades they increased at an average rate of ninety thousand new farms annually. In other words, by 1910 agriculture had passed its age of expansion so typical of the earlier period. Assuming 50,000 board feet as a reasonable estimate of the lumber required for the average farm fully equipped, there was a prospective market for 4½ billion feet of lumber annually with an increase of 90,000 farms. The full amount of this would not necessarily appear immediately, inasmuch as the average farm is perhaps not fully equipped in one year. But the loss might be expected to develop in a decade or two.

An assumption that the market previously provided by additional farms has practically disappeared since 1910 can be objected to on the ground that there has been agricultural expansion with increased number of farms in some regions, and that these increases have merely been obscured by farm abandonment in other regions. But it must be noted that farm migration is not new. Abandonment in New York State has been going on for over 50 years.2/ It may have been heavier during the last decade, but this does not nullify a comparison as to increase in farms between the last decade and the period prior to 1910. And the possible error in such a comparison would be further offset by changes in types of farms.

Instead of general expansion of agriculture there has been a shifting as illustrated by Figures 27 and 28. Abandonment in the eastern "general farm" region has been replaced in the western "grain farm" region. Although farm expansion from 1910 to 1920 offset farm abandonment on basis of number of farms, this offset does not apply when value of buildings is considered. In the regions of abandonment farm buildings averaged $2,700 to $3,100, but in the regions of expansion they averaged $700 to $2,200. This decline in value of improvements involves a corresponding difference in building-material requirements.

Agricultural Depression

In addition to the changed trend of agricultural expansion, and of greater significance in the 1928 rural lumber consumption, was the forced curtailment in normal repairs and replacements on account of agricultural depression. There is little information on the actual volume of rural construction, but such records as are available indicate that expenditures for building repair and replacement on the farms in 1928 were about half those for 1912.

On the old basis of 2,000 feet per farm as the normal annual lumber requirement for repairs and replacement, a total of 12-3/4 billion board feet would be required for 6,400,000 farms. To be in line with farm consumption another 2 billion feet might be added for rural other than farm, making the total rural lumber consumption for 1912 about 14-3/4 billion board feet. If change in agricultural expansion reduced this by 4½ billion board feet, as explained earlier, there would remain 10¼ billion board feet for normal repair and replacement. When approximately half of this amount

2/ Bulletin 490, Cornell University Agricultural Experiment Station, by Lawrence M. Vaughan, July, 1929.

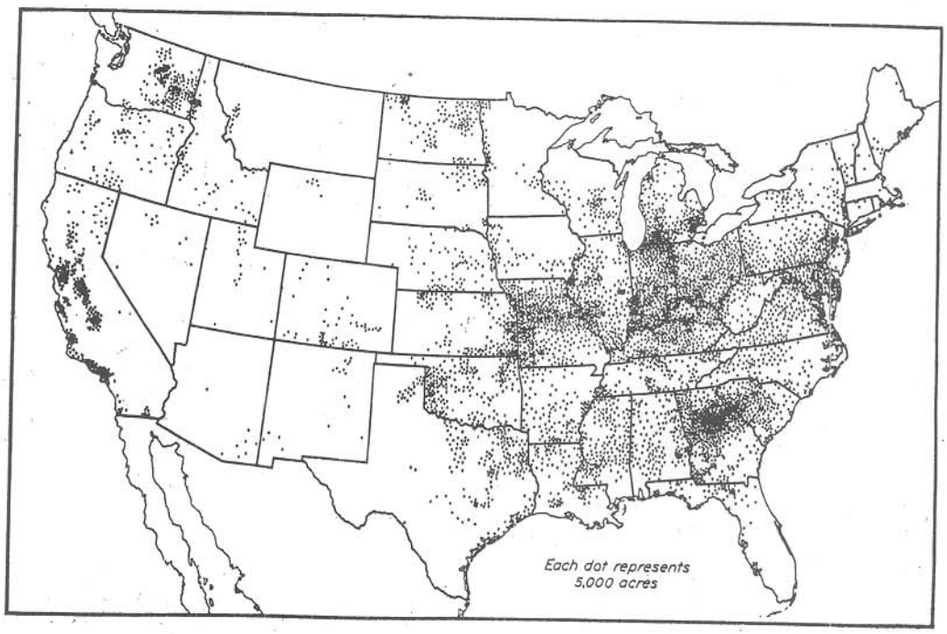

FIGURE 27—MAP SHOWING DECREASES IN ACREAGE OF ALL HARVESTED CROPS, 1919–1924.
(Based on the Census.)

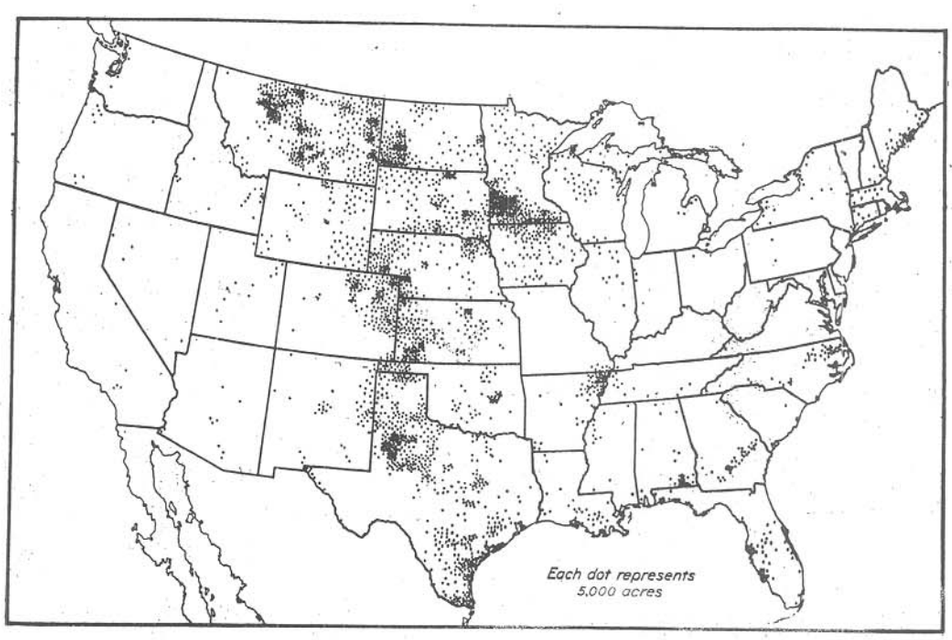

FIGURE 28—MAP SHOWING INCREASES IN ACREAGE OF ALL HARVESTED CROPS, 1919–1924.
(Based on the Census.)

is deducted for the loss due to agricultural depression, an estimated rural consumption of some 5 billion board feet remains for 1928. This, it is believed, is fairly representative of actual consumption.

It must be realized, however, that the significance of such an analysis does not rest on the accuracy of the split-up as between agricultural expansion and depression. Decline in lumber consumption due to slowing up of agricultural expansion may have been less than 4½ billion board feet and decline due to postwar depression more than 5 billion board feet, but such errors are relatively unimportant since they do not affect the validity of the conclusion that these two conditions are the major factors in rural lumber consumption trends since 1912.

Urban Construction

Residential

Contrasted with the rural situation following the World War, industrial prosperity and increasing population in the cities provided the basis for an urban building boom.

From 1920 to 1928, urban and rural-urban population increased at an average rate of slightly more than 2 million inhabitants or approximately 480,000 families, per year, as compared with an increase of 220,000 new families per year from 1890 to 1910. With an estimated normal replacement of 220,000 family accommodations the total new residential requirements for 1928 would have been 700,000 family accommodations. There was also the release of accumulated dwelling requirements due to restricted construction during the war. The abnormal volume of residential construction from 1922 to 1929 is shown in Figure 29. But even with this volume of residential construction, lumber consumption did not hold up to what it was before the war. This was due primarily to the agricultural situation already explained, but changes in residential construction are also partly responsible.

The small all-wood house uses perhaps as much lumber as ever. If less wood ceiling is used than a generation ago, double floors are in more general use now than formerly, and the modern house has perhaps more closets, breakfast nooks, and other novel features to replace wood-enclosed plumbing and other earlier uses. But the all-wood house is not as common as it was formerly. There are more materials to choose from. In a six-room house using 20,000 feet of lumber, brick veneer may displace 2,800 feet of 10-inch siding, or fiber board may displace 3,000 feet of lumber for sheathing. This does not take into account the materials that may displace wood lath and shingles, which are not measured as lumber.

However, with the demand for better housing and added features, it is possible that use of other materials has not greatly reduced the quantity of lumber per single family dwelling in 1928 as compared with 1912. Since 1912, however, the factor of multifamily housing has developed, representing by 1928 some 50 per cent of new housing.

New multifamily housing is quite generally either of masonry wall or all fireproof construction, and involves a reduction in floor area per person. It is estimated that substitution of other materials and reduction of floor area in multifamily housing

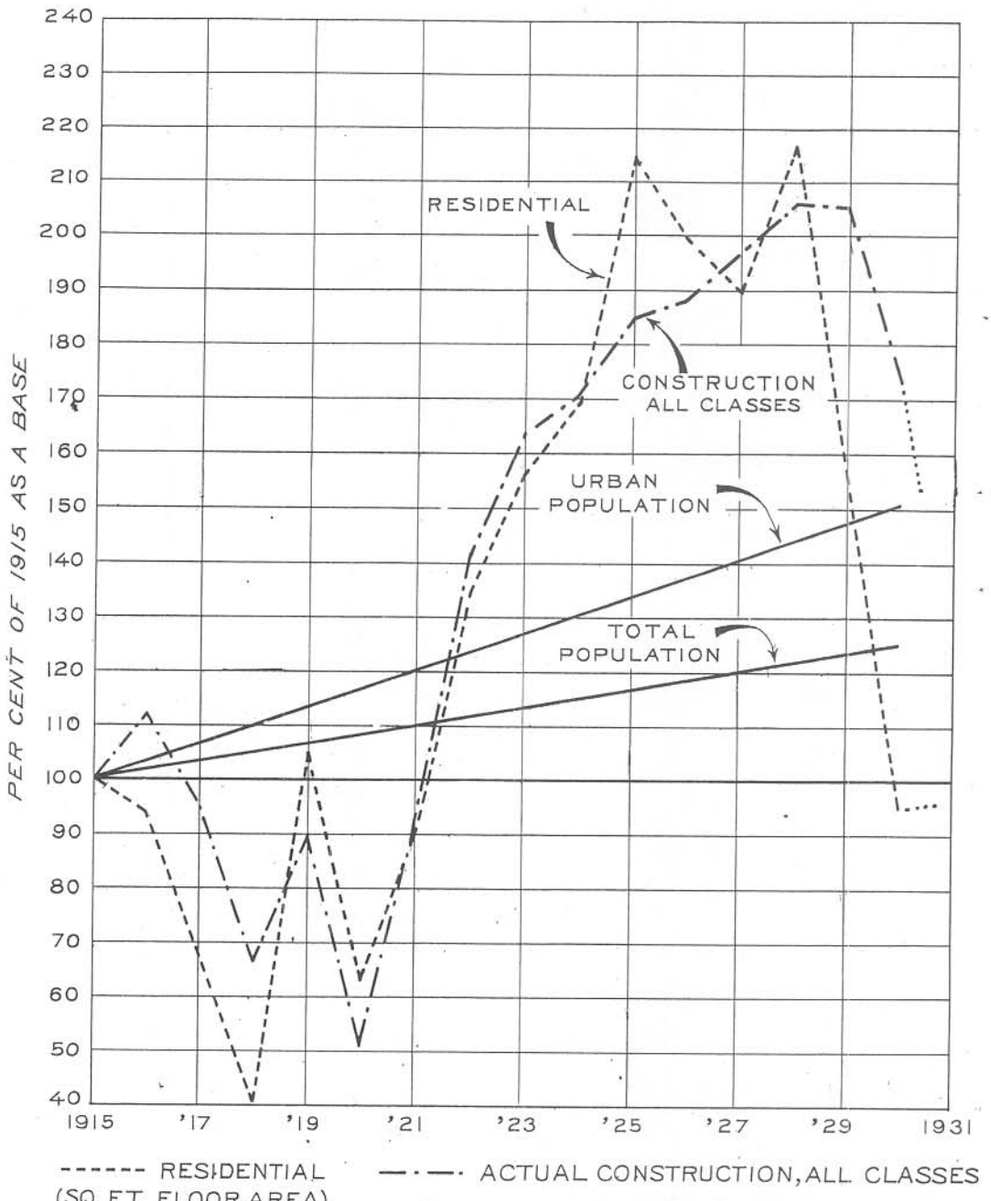

FIG. 29 – CONSTRUCTION TRENDS: RESIDENTIAL AND ALL CLASSES AS RELATED TO URBAN AND TOTAL POPULATION

reduced lumber requirements for new housing in 1928 by 20 or 25 per cent per family as compared with 1912. If multifamily housing can account for such a decline, 25 per cent is a conservative estimate for displacement of lumber in urban residential construction from 1912 to 1928.

On the basis of 20,000 board feet of lumber for the average single family dwelling of 1500 square feet floor area, the lumber requirements for 700,000 such units would be 14 billion board feet. About 15 per cent for repairs would make an estimated annual requirement of 16 billion board feet. But trends to multifamily housing and use of other materials would reduce this 25 per cent, leaving an actual requirement of say 12 billion board feet for urban residential in 1928, which is the amount already tentatively set up in Table 23.

Urban Nonresidential

Urban nonresidential construction comprises all urban construction other than residential, including engineering works, and wharf and railroad construction. It is in this field particularly that lumber has been displaced by other materials. Much of such displacement, however, had already occurred by 1912, or, in new types of construction dependent upon the use of other materials, is not looked upon as direct displacement of lumber. For example, to have provided the same floor area in mill-type construction for the Merchandise Mart in Chicago would have required five times the 11 million board feet of lumber that this modern commercial building actually consumed.

There are available fewer data in the nonresidential field than in any of the other fields. On the basis of the construction employed in the Merchandise Mart, approximately a billion board feet would have been required for commercial buildings constructed in 1928, not including railroads. Twice that figure might be a more reasonable estimate in order to allow for the probability that smaller buildings used a larger proportion of lumber. Railroad construction accounts for another billion feet of lumber, (excluding car construction, which comes under factory consumption, and ties, reported separately.) There are still the items of wharf construction, engineering works, and all miscellaneous construction. Perhaps a total consumption of 5.4 billion feet, the amount yet to be accounted for in the 1928 consumption of 36.5 billion board feet, is not too large an estimate for 1928 nonresidential construction. Notwithstanding twice the volume of construction, this estimate of lumber consumed in nonresidential construction in 1928 is about the same as for 1912. Whether because of direct substitution or owing to new types of construction, lumber requirements for nonresidential construction measured on the 1928 basis are only half what they would have been if 1912 conditions had persisted.

Factory Consumption

Lumber consumed in fabricated products or by wood-using industries ranges from one-fourth to one-third of the total lumber consumption. Consumption in this field for 1928 was only 8 per cent below the 1912 figure, a decrease of less than a billion feet. Comparison of lumber consumed by the various industries in 1928 and that used in 1912, as afforded by statistical studies in the wood-using industries, is given in Table 24.

Table 24 - Lumber consumed in fabricated products and by wood-using industries, 1912 and 1928

Products	1912	1928
	M ft. b.m.	M ft. b.m.
Boxes and crates	4,550,016	4,981,230
Car construction	1,262,090	1,009,408
Furniture	944,678	1,198,612
Vehicles and vehicle parts (non motor)	739,144	80,841
(motor)	..	937,875
Total of 4 principal industries	7,495,928	8,137,966
Woodenware, novelties, and dairymen's poulterers', and apiarists' supplies	405,286	183,336
Agricultural implements	391,239	142,943
Chairs and chair stock	289,791	165,392
Handles	280,255	124,654
Musical instruments	260,195	107,502
Tanks and silos	295,620	66,328
Ship and boat building	199,598	128,342
Fixtures	187,133	130,030
Caskets and coffins	153,395	156,108
Refrigerators and kitchen cabinets	137,616	145,745
Matches and toothpicks	85,442	123,426
Laundry appliances	79,502	38,674
Shade and map rollers	79,292	24,236
Paving material and conduits	76,067	3,350
Trunks and valises	74,668	21,346
Machine construction	69,459	39,627
Boot and shoe findings	60,240	48,742
Picture frames and moldings	65,478	20,947
Shutters, spools and bobbins	65,148	44,022
Tobacco boxes	64,127	38,429
Sewing machines	59,947	13,760
Pumps and wood pipe	55,827	10,831
Pulleys and conveyors	55,865	900
Toys	33,827	39,410
Gates and fencing	27,451	1,572
Sporting and athletic goods	25,192	29,973
Patterns and flasks	24,299	29,996
Bungs and faucets	21,112	2,980
Plumbers woodwork	20,313	16,273
Pencils and pen holders	20,000	39,082
Electrical machinery and apparatus	18,189	66,750
Mine equipment	18,988	22
Professional and scientific instruments	15,071	15,510
Brushes	12,879	17,033
Dowels	11,981	15,087
Elevators	10,018	46
Saddles and harness	9,218	751
Playground equipment	9,065	4,672
Butchers' blocks and skewers	8,197	4,888
Clocks	7,894	3,511
Signs and supplies	6,888	48,597
Printing material	5,325	5,984
Weighing apparatus	5,022	19
Whips, canes, and umbrella sticks	4,947	1,250
Brooms and carpet sweepers	2,277	28,452
Firearms	2,094	1,741
Artificial limbs	687	698
Tobacco pipes	490	1,411
Airplanes	74	9,044
Motion pictures and theatrical scenery	..	16,233
Total of 50 minor industries	3,651,766	2,179,545
Total, all uses	11,147,694	10,317,511

The first four items - boxes and crates, car construction, furniture, and vehicles, - represent roughly 80 per cent of the total factory consumption. Requirements for these four have increased 10 per cent since 1912, whereas the other 50 items, which account for only 20 per cent of total consumption, have decreased about 40 per cent, or roughly 1.5 billion feet. Although the net loss is small in comparison with the loss in construction, there is no significant increase in consumption of any of these minor items to warrant hope of great expansion in the future.

Boxes and Crates

Consumption of lumber for boxes and crates is by far the largest item in factory consumption and represents nearly half of the total 1928 factory lumber consumption. The 1928 consumption is 10 per cent greater than that in 1912, but represents a decline of nearly 20 per cent from a peak of 6 billion board feet in 1918. In the course of the decline since 1918 there has been a 25 per cent increase in package freight. The fact that the rise in package freight has not been accompanied by an increase in wood boxes, is due chiefly to the competition of fiber boxes.

Competition between lumber and fiber board for boxes rests chiefly on consumer costs. The average fiber box weighs about one-third as much as a wooden box of the same size. Freight and handling charges on the wooden box, however, will be somewhat less than three times what they are on the fiber box because the wooden box averages larger and distributes the charges over larger contents. Improvements in design and construction have reduced the weight of wooden boxes about 25 per cent in the last 10 years. Further reduction could be made by more general application of information now available, but this would not materially broaden the field of wooden containers. However, reduction in weight would be in the larger sizes where there is little competition. Changes that are taking place in transportation and handling methods favor the fiber box. It should, of course, be realized that the use of fiber boxes represents in itself an appreciable quantity of wood consumed.

From present indications, it does not seem likely that lumber requirements for boxes and crates will go above the 1928 figure. A decline is not improbable.

Car Construction

The use of lumber in railroad car construction shows a decline of 252,682,000 board feet, or 20 per cent, since 1912. During this period freight car construction has fluctuated violently, dropping from a peak of 335,000 cars in 1905 to 65,000 in 1908, climbing to 190,000 in 1909, going down to 98,000 in 1910, up to 180,000 in 1912, and down again to 80,000 in 1914. There were 98,000 cars built in 1925 and 72,400 in 1927.3/

Changes in type of construction were very rapid between 1905 and 1910. The 275,000 all-wood freight cars built in 1905 constituted 82 per cent of all cars; in 1910 the 38,000 all-wood cars were only 39 per cent; in 1912, 8,500 such cars constituted 4.7 per cent; in 1925, 7,700 amounted to 7.9 per cent; and in 1927 the 350 all-wood cars manufactured were less than 0.5 per cent of the total.4/ Changes in

---

3/ From Wood Using Industry Reports.

4/ From Report No. 117, U.S.Dept. of Agr., and American Lumberman, 12-21-29.

design of part-wood freight cars are being made continually, but without greatly changing the present average wood consumption per car, which in 1912 was around 2,000 feet per car. Passenger cars are few in number as compared with freight cars, but they show the same trend away from all-wood construction.

Furniture5/

Consumption of lumber for furniture increased a little over a quarter of a billion board feet from 1912 to 1928, or 25 per cent. This is not so far out of line with the increases in population as to indicate increasing displacement of lumber by other materials.

From 1925 to 1929 metal furniture increased 17-1/2 per cent while wood furniture (including fiber, rattan, reed, willow) shows an 8 per cent gain. The entire gain for metal was in furniture and fixtures for offices, stores, and public buildings, and for laboratories, hospitals, barber shops, and beauty parlors. Metal actually dropped off 30 per cent in household furniture, while wood increased 7 per cent. In 1929, 60 per cent of metal household furniture was for the bedroom, and this item declined 50 per cent from 1925 to 1927.

Metal furniture made up 12 per cent of the value of all furniture in 1929, but only 5 per cent of household furniture. It contributes a third of the value of furniture and fixtures other than household, and here has been holding its own during the last few years.

Minor Industrial Uses

The more conspicuous changes in the minor items have occurred as the result of normal social and economic changes, and in many instances these are largely compensatory. For example, developments in the power field brought about a drop in nonmotor vehicle requirements but, in replacing the nonmotor with the motor vehicle as a consumer of wood, more than equalled the earlier demand. Most of these developments do not indicate directly the competition of other materials with wood, but rather a change in requirements which producers of lumber and wood products have not been prepared to meet.

The increase in consumption of lumber in 1928 as compared with 1912 for such items as motor vehicles, airplanes, and motion pictures may be somewhat misleading, inasmuch as these are new. For instance, annual production of motor vehicles increased 21 per cent from 1924 to 1928, but lumber consumption in motor vehicles dropped 4 per cent. Similarly, while consumption of lumber for airplanes has increased since 1912, the amount of wood per plane has decreased in favor of other materials. The amount of plumbing has increased, but the use of lumber for plumber's work has decreased. Manufacture of laundry appliances has more than doubled, but amount of lumber used in such appliances shrunk one-half. A preference for other materials has tended to eliminate wood in all these fields.

5/ Data from Census of Manufactures.

Tentative Normal Lumber Requirements

Table 25 presents an estimate of present (1931) normal lumber requirements. The difference between normal and actual requirements may, however, be considerable. Normal requirements are understood to be the volume of consumption that might logically be expected when general economic conditions are such that we are conscious neither of depression nor of unusual prosperity.

Actual requirements will vary from the normal under the influence of various conditions, as for instance the present general depression, or the earlier agricultural depression which held agricultural consumption below normal while industrial prosperity ran urban consumption above normal. Such factors sufficiently persistent may establish a new lower or higher base for the normal trend of consumption. Normal trend is more seriously affected, however, by such broader influences as population and national wealth. Stabilization of population, multifamily housing, and concentration of farming on a highly intensive scale are conditions that have a direct effect on normal lumber consumption for home and farm building.

Separate consideration of each major line of consumption is necessary, both as to direction of trend and percentage of total volume. Deviations from normal in one line may have little or great effect on another, depending upon their interrelation and the volume of lumber involved.

With a return of normal agricultural conditions there may be a prospective 5 billion board feet increase over present rural lumber consumption. How is the current urban-to-farm movement related to this prospective market recovery? If recovery of urban residential construction involves a return to lower price class, where the all-wood house has predominated, how will this be reflected in lumber consumption?

It is doubtful whether a normal as set up at this time can correctly take account of replacement, which is a major factor in future construction requirements. Number of dwellings has more than doubled in the 40 years since 1890. Using a 40-year replacement period for convenience of illustration, normal replacements by 1970 should be twice the normal replacements for 1930, which would almost maintain present normal requirements for new dwellings without an increase in population after 1970. The lumber requirement would, however, be further dependent upon future trends in type of construction and competition of other materials.

Competition with Other Materials

There is possibly a certain advantage to be gained for lumber if lumbermen can successfully brand competing materials as substitutes; but the fact remains that lumber is now one of a number of competitive materials, with new competitors appearing continually. Lumber must not only compete with other materials, but must compete under changing conditions. This is typical of our industrial age and is not peculiar to lumber. There may, however, be some disadvantage to lumber in the fact that it has so long held, by virtue of mere cheapness, a field into which research has only lately introduced new and far more exacting standards.

Table 25 - Estimated present normal lumber consumption in comparison with totals for 1912 and 1928

Class of use	1912	1928	Estimated present normal
	Billion ft.b.m.	Billion ft.b.m.	Billion ft.b.m.
Rural construction	15.0	5.5	10
Urban residential	9.0	12.0	6 - 8
Urban nonresidential	5.3	5.4	3 - 3.5
Sash, door, and millwork	2.5	3.3	2 - 2.5
Factory	11.2	10.3	10
Total	43.0	36.5	31 - 34

Through changing industrial conditions competition in cost has changed from a mere matter of cost on the job to more vital considerations, such as labor cost in assembly, time cost in delayed rents, and cost of maintenance. Lumber still holds the small-house field because of lower cost of material, but competitors are trying to overcome this advantage by new methods of erection. The old type of barn with heavy plank frame was wasteful of material and space, and more wasteful of labor, requiring 30 men for its erection. It has been replaced by lighter types of construction that can be put up by 5 men. Any defects in design of the new type, which may result perhaps in a sagging roof, will not mean a return to the old method of construction, but will invite competition from other materials or still further improvement in methods of wood construction.

A requirement for sheathing may change to a requirement for insulation. A requirement for bridge material to suit the local carpenter may change to a requirement to suit a State highway department specification for "permanent type" of construction. The vehicle industry once demanded a material suitable to the craftsman whereas now the demand is for mass production. A cotton mill architect who must keep his inspector at the saw mill to insure delivery of timbers according to specification may, as an alternative, use some other material.

Some exceptions can be made, but generally it may be said that the consumer of lumber has had to adapt his specifications to the convenience of the manufacturer, whereas competing materials have been developed to meet the consumer's needs, even in advance of the consumer himself being aware of the need. The story of competing materials, both in development of the materials and in their merchandising, differs most conspicuously from that of lumber in the degree to which lumber has maintained its independence of scientific research.

How this attitude has operated to lumber's cost may be estimated in the many inroads that other materials have made by virtue alone of the discovery of better methods and processes. Riveting had provided a good joint in steel construction, but the welded joint has opened new fields for steel. The joint has always been a source of weakness in wood construction, but it may be that through research a new joint will be perfected that will do for wood products what welding is doing for steel. Rustless steel has found new markets for steel, and methods to secure freedom from effects of moisture might be worked out that would do much the same for wood. Greater resistance to fire and to wear, and proper use of wood to take advantage of its durability are discoveries that will give wood new possibilities. Research may well improve upon types of wood construction that have been handed down for centuries with little change. The fact that competitors have reached their present status largely as a result of scientific research is not evidence that the same thing can be done with lumber, but it does point to lumber's weakness in present-day competition. Scientific research will continue a major factor in future lumber requirements whether by way of increased competition of other materials or by way of new markets for lumber.

Hardwoods versus Softwoods

The declining consumption of lumber is reflected about equally in hardwoods and softwoods since 1899, as shown by Table 21. For the 10 year period from 1919 to

1928 hardwoods represented some 19 per cent of the total as against perhaps 23 per cent in the period 1909 to 1918. This suggests a greater rate of decline for hardwoods than for softwoods.

Of course the same factors are at work in both hardwoods and softwoods, although perhaps not to the same degree in specific cases. The rural factor would no doubt affect softwoods more than hardwoods, and this would be true also in the use of brick veneer, stucco, or other exteriors in place of wood in residential construction. On the other hand, the fact that wood furniture has held its own should affect the hardwoods more than the softwoods.

There is also the factor of competition between hardwoods and softwoods. It is known that in the motor vehicle industry softwoods have displaced hardwoods for some purposes. In furniture, the trend to upholstered furniture has meant some use of softwoods in place of hardwoods. Competition in wood flooring exists between different hardwoods, maple and oak, for example, but also between hardwoods and softwoods. Why was consumption of oak flooring in 1928 four times that of 1919 whereas consumption of maple flooring actually declined?

As more data become available, it will be possible to extend such an analysis to show the situation in greater detail.

Pulpwood Requirements

Since the great bulk of pulpwood goes into the manufacture of paper, including fiber products, and over 90 per cent of such products are made from wood pulp (Table 26), the consumption of these products is a practical measure of pulpwood requirements. The high consumption of paper products in this country is frequently attributed to the development of wood as a source of pulp, but the facts would seem to indicate that the pulping of wood was more an effect than a cause of our high paper consumption. Figure 30 shows that the trend of per capita consumption has maintained a uniform rate of increase over a 120-year period without appreciable variation due either to the change from rags to wood pulp or the introduction of new processes at various times. Whether the extension of the curve to 1950 without modification is justified, is of course a moot question. High per capita consumption of paper products is possibly a normal expression of our American type of civilization, which, lacking wood pulp, would still have prevailed, through the medium of some other raw material.

Attempts have been made from time to time, and are still being made, to pulp other fibrous plants, both cultivated crops and wild plants. Esparta, straws, bagasse, and cornstalks are being used to some extent. But wood is probably the most compact form of cellulose and of fiber that exists in nature and, by virtue of this fact, the cheapest and easiest raw material to handle. Wood dominates the field and there is no apparent reason at present for anticipating the displacement of wood by any other raw material for paper, provided suitable supplies of wood continue conveniently and cheaply available.

Analysis of Trends in Paper Consumption

Paper consumption falls into six general classes - fine, book, newsprint, wrapping, board, and all other. Table 27 and Figure 31 afford a comparison of these classes in relation to total use.

Table 26 – Raw materials consumed in United States paper manufacture

Year	Wood pulp	Rags	Paper stock	Manila stock	Straw	All other	Total raw materials	Total paper produced
	Short tons	Short tons	Short tons	Short tons	Short tons	Short tons	Short tons	Short tons
1879	1/ 22,570	200,005	87,840	84,786	245,838	1,218	642,257	452,107
1889	349,917	246,892	139,061	524,862	355,131	..	1,615,863	934,611
1899	1,172,880	234,514	356,193	99,301	367,305	..	2,230,193	2,167,593
1904	2,018,764	294,552	588,543	107,029	304,585	..	3,313,473	3,106,696
1909	2,826,591	357,470	983,882	117,080	303,137	29,422	4,617,582	4,216,708
1914	3,490,123	361,667	1,509,981	121,170	307,839	97,276	5,888,056	5,270,047
1919	4,019,696	277,849	1,854,386	116,994	353,399	106,850	6,729,174	6,190,361
1929	6,289,318	739,422	3,841,942	128,800	575,263	2/ 626,812	12,201,557	11,140,235

Bureau of the Census. Calendar years.

1/ Production: exports and imports, not reported, are assumed to be equal.

2/ Reported as clay, rosin sizing, rosin, and casein.

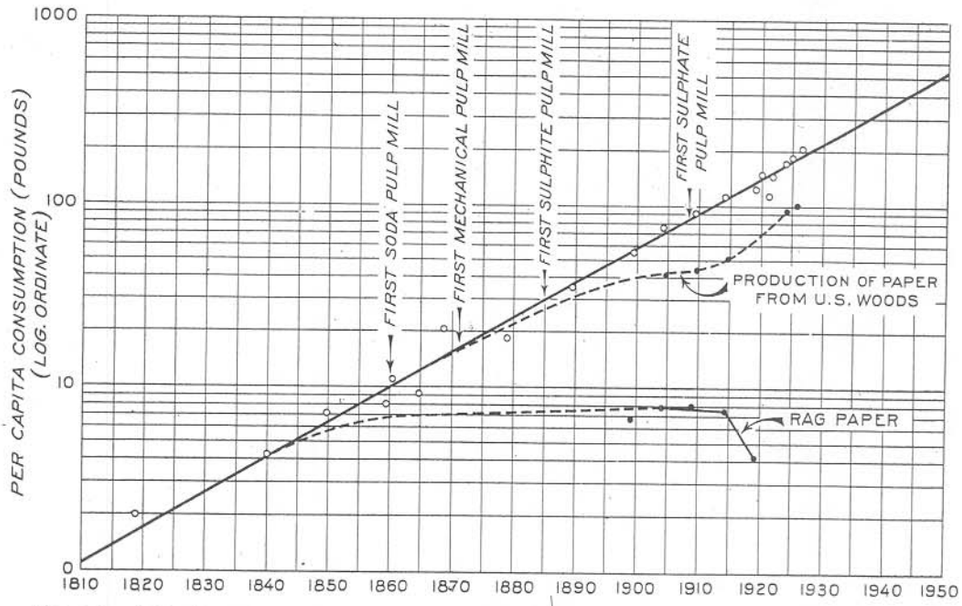

FIG. 30— TOTAL PER CAPITA CONSUMPTION OF PAPER AND BOARDS, AS RELATED TO USE OF WOOD PULP AND RAGS

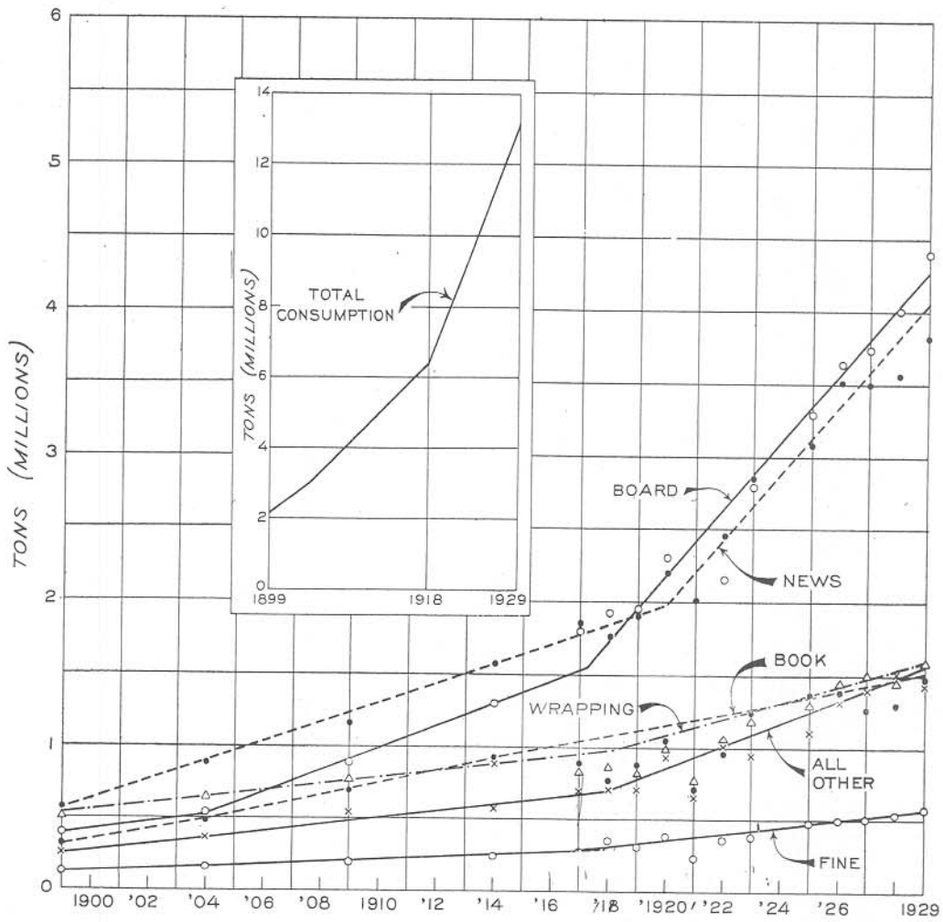

FIG. 31 — PAPER CONSUMPTION BY KINDS

Table 27 - Paper consumption, by kinds, and per capita, specified years, 1810-1929 1/

Year	Newsprint		Book		Boards		Wrapping		Fine		All others		All kinds	Total per capita
	Short tons	Per cent	Short tons	Per cent	Short tons	Per cent	Short tons	Per cent	Short tons	Per cent	Short tons	Per cent	Short tons	Pounds
1810	..	..	..	..	..	..	..	..	..	..	..	..	2/ 3,000	1
1819	..	..	..	..	..	..	..	..	..	..	..	..	2/ 12,000	2
1839	..	..	..	..	..	..	..	..	..	..	..	..	2/ 38,000	4
1849	..	..	..	..	..	..	..	..	..	..	..	..	2/ 78,000	7
1859	..	..	..	..	..	..	..	..	..	..	..	..	2/127,000	8
1869	..	..	..	..	..	..	..	..	..	..	..	..	391,000	20
1879	..	..	..	..	..	..	..	..	..	..	..	..	457,000	18
1889	..	..	..	..	..	..	..	..	..	..	..	..	1,121,000	36
1899	569,000	26	314,000	15	394,000	18	535,000	25	113,000	5	233,000	11	2,158,000	57
1904	883,000	29	495,000	16	521,000	17	644,000	21	142,000	5	365,000	12	3,050,000	74
1909	1,159,000	27	689,000	16	883,000	21	763,000	18	193,000	5	537,000	13	4,224,000	93
1914	1,576,000	29	926,000	17	1,292,000	24	892,000	16	244,000	4	566,000	10	5,496,000	112
1917	1,824,000	29	846,000	14	1,805,000	29	814,000	13	276,000	4	691,000	11	6,256,000	122
1918	1,760,000	28	800,000	13	1,927,000	30	859,000	13	348,000	5	693,000	11	6,387,000	123
1919	1,892,000	29	838,000	13	1,940,000	30	825,000	13	306,000	5	692,000	10	6,493,000	124
1920	2,196,000	28	1,060,000	13	2,301,000	29	1,003,000	13	371,000	5	930,000	12	7,861,000	148
1921	2,002,000	33	707,000	11	1,641,000	27	770,000	13	230,000	4	704,000	12	6,054,000	112
1922	2,451,000	31	968,000	12	2,154,000	27	1,059,000	13	356,000	4	1,015,000	13	8,003,000	146
1923	2,814,000	30	1,235,000	13	2,802,000	30	1,177,000	13	374,000	4	938,000	10	9,340,000	168
1925	3,073,000	29	1,365,000	13	3,290,000	31	1,287,000	12	472,000	5	1,103,000	10	10,590,000	184
1926	3,517,000	30	1,408,000	12	3,637,000	31	1,435,000	12	495,000	4	1,315,000	11	11,807,000	202
1927	3,492,000	29	1,265,000	11	3,737,000	31	1,515,000	13	502,000	4	1,404,000	12	11,915,000	202
1928	3,561,000	29	1,321,000	11	4,009,000	32	1,457,000	12	538,000	4	1,562,000	12	12,448,000	208
1929	3,813,000	29	1,474,000	11	4,385,000	32	1,586,000	12	593,000	4	1,578,000	12	13,429,000	219
1930														
1931														
1932														
1933														
1934														
1935														
1936														
1937														
1938														
1939														
1940														

A computed table based on data credited in the tables of compiled record. Printed as Table 3, U.S.D.A. Bulletin 1241, 1810-1922.
Tons of 2,000 pounds.

1/ Imports added to United States production and domestic exports deducted.

2/ Domestic production only, value of exports and imports being approximately equal. No data for 1829.

Newsprint

Of all papers newsprint, although in recent years exceeded in volume by boards, is the most important. Demand for newsprint for newspaper publication is concentrated in the large cities, nearly 90 per cent of the total newsprint production being consumed by 15 per cent of our dailies.6/ The rate at which the demand for newsprint is growing can be measured quite adequately by the increases observable in circulation and size of issue of the representative metropolitan newspapers. Figure 32, showing the general trend in size of issue for a number of dailies in different parts of the country gives evidence of the close relation between this factor and newsprint consumption. (The London Telegraph indicates a similar trend in England to 1920.) Total newspaper circulation increased 37 per cent from 1920 to 19307/, or 3.7 per cent a year. Since total consumption of newsprint increased 70 per cent from 1920 to 1926, or 11.7 per cent a year, it is evident that size of issue is the major factor in newsprint consumption.

On the other hand, circulation is not a guide to number of pages, except that the average number of pages for circulations from 100,000 to 300,000 is apparently 20 per cent greater than for circulations under 100,000, and for circulations above 300,000 is again about 20 per cent greater. However, the range within each group is wide and there is no clear division between the groups. The maximum number of pages maintained by the largest dailies is around 45, regardless of circulation, and only a few have reached that status. This may or may not suggest a practical limit for the newspaper as we know it now, and it does not preclude the possibility of some new factor changing such a limit.

Back of all growth in newspaper circulation are, of course, the basic factors of literacy and population increase. Here again, the greatest influence is concentrated on the metropolitan newspapers, since increases in population have been greatest in the metropolitan areas. As the population curve falls off and the literacy curve approaches 100 per cent, their influence on circulation slackens.

What the future size of our newspapers will be is more difficult to estimate than is the probable circulation trend. Advertising largely controls the number of pages, and decline in advertising has reduced the size of newspapers for the past several years. Laird has estimated that the newspaper's share of some $320,000,000 spent for advertising was 62½ per cent in 1922 but only 46 per cent of the $513,000,000 spent in 1929. This seems to raise the question as to whether the newspaper is holding its own in competition for advertising.

Fiber Boards

From a quantitative point of view, fiber boards have surpassed the newspaper in pulpwood consumption. The two largest uses for boards are for construction (wallboards, insulation, sheathing, forms, and the like) and for shipping containers. There is no reason to feel that a saturation point for such boards is yet within view. Fiber boards are comparatively new in construction and possibilities for further extending their use can reasonably be considered as better than when they were first introduced. Insulation against heat and cold has advanced from a novelty to a necessity. And the demand is being extended to include insulation against sound.

6/ From report by H. A. Laird, Mgr. Traffic Dept., Chicago Tribune, 1930.

7/ From a report by R. S. Kellogg of the News Print Service Bureau, October 27, 1931.

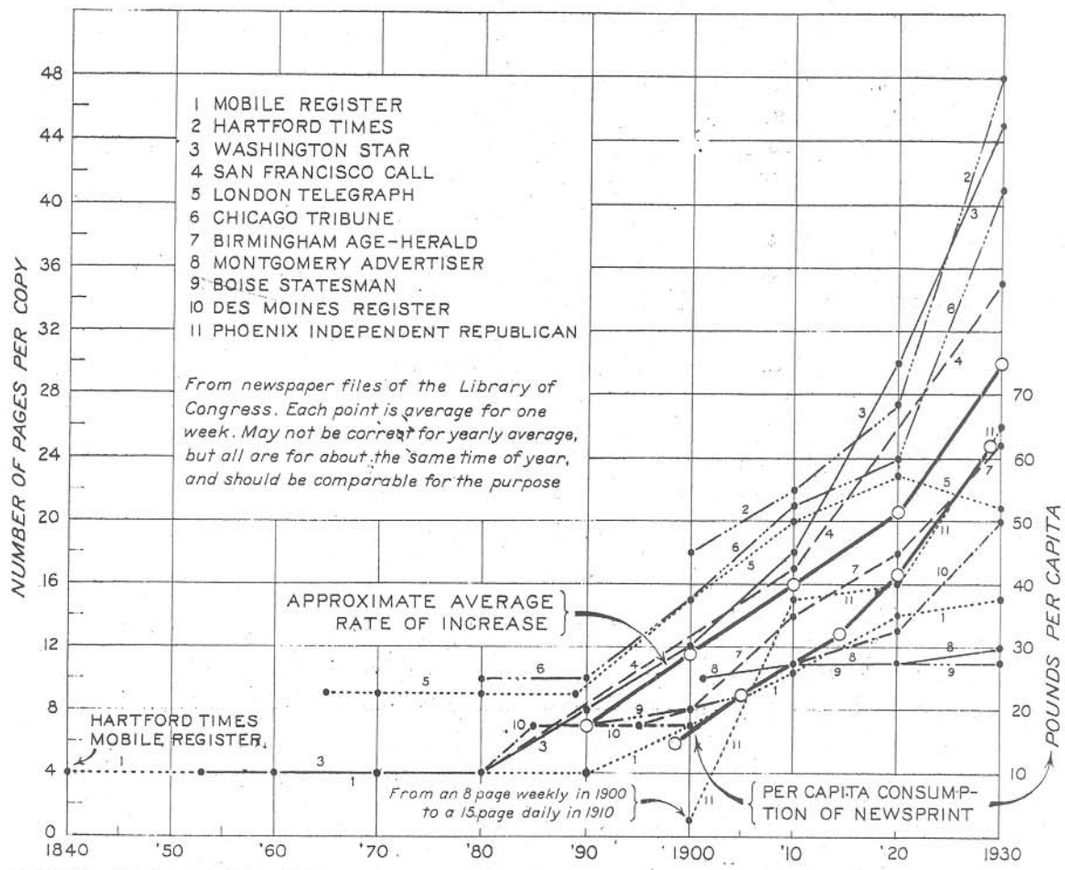

FIG.32 INCREASE IN NUMBER OF PAGES PER COPY OF DAILY PAPERS SINCE 1880

Demand for fiber board for shipping containers should continue to increase. One of the major factors is the change from bulk to package handling of commodities, as typical of our changing social life. The trend is illustrated by the rapid increase in freight package goods whereas total freight originated on Class I railroads has increased very little over the past decade.

Factors in favor of increased use of fiber board containers are the changes in transportation and handling methods which reduce the strength requirements of containers, the economies possible with pre-packing of merchandise, and the possibilities of increasing usefulness through continued research.

Other Classes of Paper

Book, wrapping, fine and all other classes have shown a slower but more uniform rate of increase than newsprint and boards. Of these minor classes, the all other is increasing at the greatest rate and has reached a volume where it may be advisable to split it up farther to better analyze the factors involved.

Future Paper Requirements

In Figure 31 recognition was given to the fact that consumption of paper, like all manufactures, dropped below normal in 1921 and then increased at a greater rate. If, instead of attempting to show the trend as a continuous smooth curve, a break is made after the war, then trends before and after the war are seen to be fairly straight lines. A continuation of the postwar trend on this basis would show a 1950 requirement of 28 million tons of paper, or, roughly, 30 million cords of wood. However, there is a question as to whether we have as yet arrived at a normal trend for paper, and whether the prewar trend was normal. A return to prewar trends by other manufactures may mean a return to the prewar trend for paper, or a 1950 requirement considerably below 28 million tons. Much will depend on the future trends for the two largest items, newsprint and fiber boards. And, of course, the possibility of new developments which might increase consumption of paper products can not be overlooked.

Pulpwood requirements for boards and miscellaneous pulp products are even more uncertain than for newsprint, because of greater variety of uses, element of competition, uses not so definitely established as necessities, and the ever present prospect of developing new uses surpassing those now recognized. In general it is safe to conclude that the saturation point has not yet been reached, that is, normal consumption in future will continue to increase faster than population. How much faster should be a matter for continuous observation and in most cases there will be a close relation to conditions in a particular field, which can be subjected to continuous observation. For instance, volume of building construction will have a direct effect on consumption of wallboards, insulating materials, and the like while volume of package freight will have a direct effect on consumption of container boards.

Cellulose Products

Besides paper requirements for pulp, there is the relatively small but rapidly growing requirement for cellulose products, of which the chief at present is rayon.

This requirement is important not from volume of present consumption but from its prospects for the future. Figure 38/ represents the status of rayon up to 1928, quantity production and value. Rayon is yet too new a product to permit its future pulp requirements to be estimated. Its status in only a few years has changed from that of artificial silk to a new textile in its own right; and from competition with silk alone to competition with cotton, and even wool.

Imports

In any analysis of our pulpwood requirements it is impossible to omit discussion of imports.

Imports of pulpwood vary from year to year but have a consistent upward trend as shown in Figure 34. There are reasons to believe that this upward trend of pulpwood imports has about reached a maximum, chiefly due to restrictions on Canadian pulpwood exports. Pulpwood imports are confined chiefly to New York, Pennsylvania, and the Lake States, but increasing paper production since 1919 in these regions has been maintained even more by increased imports of pulp than of pulpwood. The quantity of wood used to supply the United States with paper doubled from 1919 to 1929, but only one-third of this expansion was supplied by our own pulp and pulpwood industries. Even this proportion could not have been maintained, had not the newer regions, the South and West, successfully competed with the growing pulp resources of foreign countries. Comparison of pulp and pulpwood imports with consumption of pulpwood in the South and West does not show the full extent of the competition. The real extent of competition of foreign resources with our own is shown in Figure 35.

However, this growth in imports has not affected, and is not likely to affect, our paper consumption. Considering the development of new pulpwood regions and species, both in this country, and in foreign countries, it may possibly be said that pulp resources have increased even faster than requirements. At present there is no indication of a future shortage of paper; but that fact is of little assistance in the problem of keeping the pulp industry at home. To what extent the industry can be kept at home is a question that will have considerable bearing on what our future pulpwood requirements will be.

Railroad Crossties

Crossties purchased during 1929 (including bridge and switch ties reduced to crosstie equivalents) amounted to 95,521,200 ties.

On a per capita basis, consumption of ties has declined about 45 per cent since the peak year of 1906. This decline almost parallels that of lumber with the important difference that preference for other materials has not been a conspicuous factor in the decline of crossties. It is due almost entirely to the improvements in preservative treatment and mechanical protection that are greatly increasing the average life of ties, and also the fact that the mileage of new track constructed annually is declining and is likely to continue to do so.

8/ From an address by Dr. Chas. H. Herty, before the Engineering Foundation.

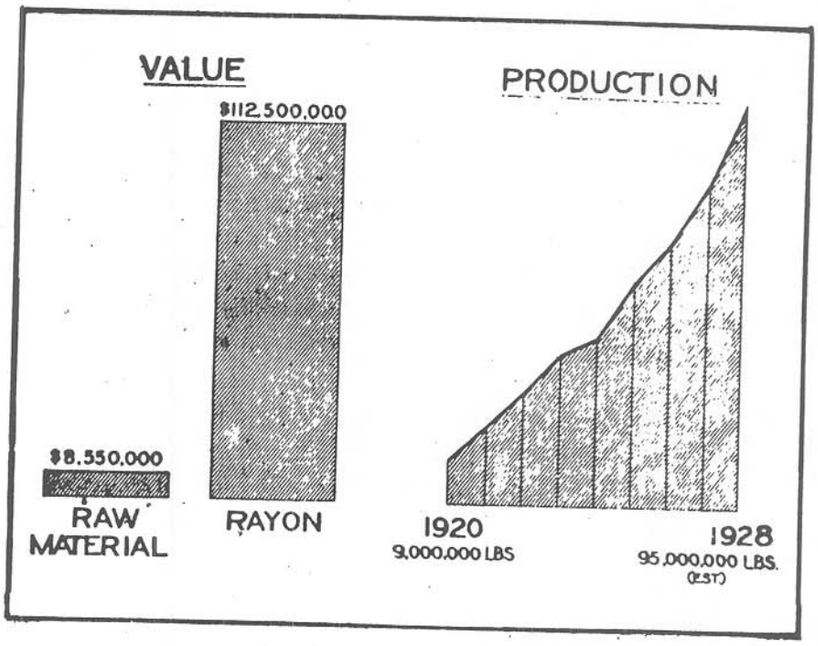

FIG. 33 RAYON PRODUCTION SINCE 1920

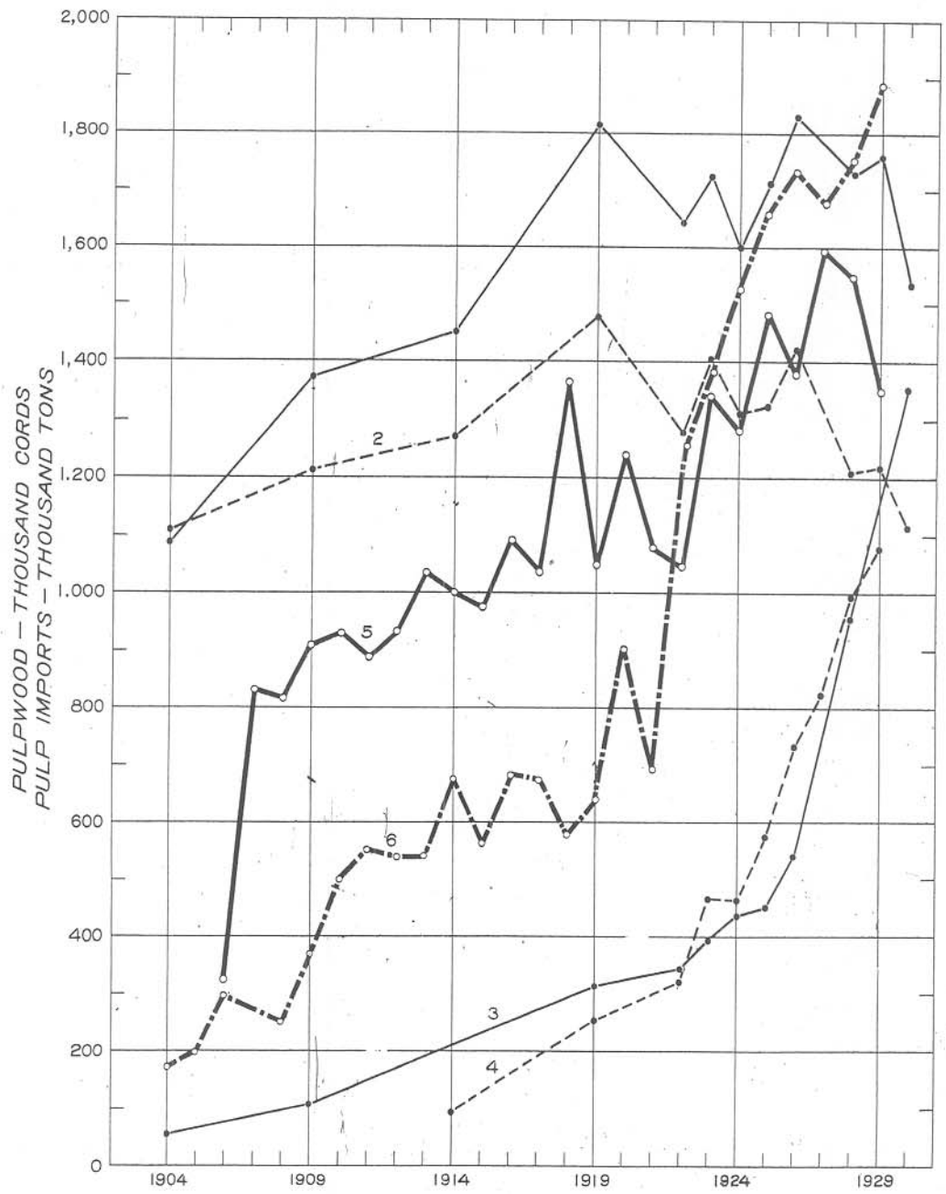

FIG.34- GROWTH IN IMPORTS OF PULPWOOD AND WOOD PULP CONTRASTED WITH REGIONAL PULPWOOD PRODUCTION IN THE UNITED STATES

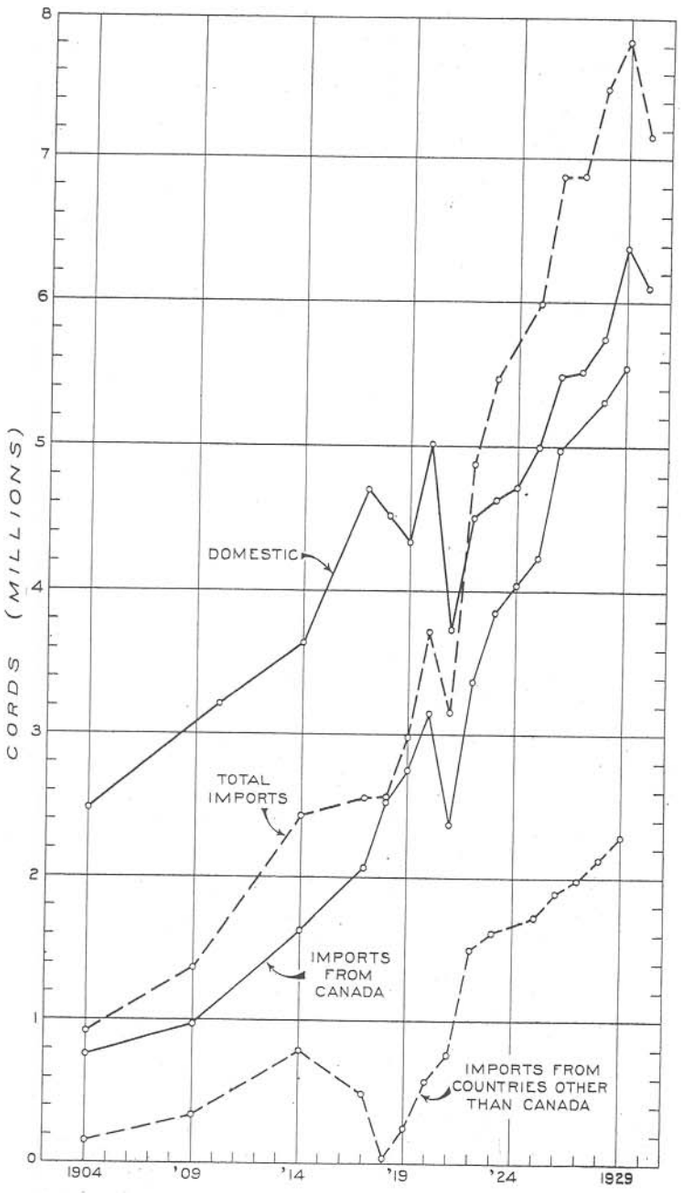

FIG. 35 - IMPORTS OF PULPWOOD, PULP, AND PAPER, CONTRASTED WITH DOMESTIC PULPWOOD CONSUMED. (ALL PRODUCTS REDUCED TO PULPWOOD EQUIVALENTS)

According to the records of the American Railway Engineering Association, the average figure for renewals on the principal railroads was 261 ties per mile for the five years ending with 1915. In 1929 the five-year average was 180 ties per mile, marking a steady decline of 31 per cent. This trend will probably continue until, possibly by 1945 or 1950, the average annual requirement for replacements is less than 125 ties per mile. Several railroads are already below this figure.

The mileage of railroad in the country has been decreasing since 1916, as shown in Table 28 9/, but the building of additional main tracks, sidings, and yards, shown as miles of track, has kept up at the rate of about 3,000 miles per year. It is not possible to say how long this rate of increase will continue but the encroachments of automobiles, busses, and trucks upon rail business and the increasing use of trucks and busses by the railroads themselves make it very doubtful that the annual net increase of 3,000 miles will be maintained. The number of ties required per year for new construction is therefore likely to decline.

Should tie renewals drop to 120 per mile annually by 1950, then 51 million ties will be required in that year to maintain the 1928 mileage of 427,750 miles. If the present mileage increase of 3,000 miles per annum is maintained, the 66,000 additional miles by 1950 will require replacements of 8 million ties annually. New construction at the present average rate of 3,000 miles per year and 3,000 ties per mile will require 9 million ties, making a total requirement of more than 68 million ties in 1950.

Obviously, this figure is based on assumptions that may prove incorrect, and any such prediction is also complicated by the uncertainty as to the changes that may take place in transportation methods in the next 10 or 15 years, which may greatly affect railway mileage and the building of new track. Furthermore, although railroad engineers generally consider the wood tie more suitable than any other, there is no assurance that wood will always remain supreme for this purpose. Wood tie producers will do well to make continued efforts to retain the market for wood.

Fuelwood

As noted in the earlier discussion of forest drain, fuelwood is next to lumber in quantity and represents some 28 per cent of the total drain. Table 16 shows fuelwood cut from commercial forests estimated at over 61 million cords. Although this is a large figure, it is considerably less than earlier estimates, as might be expected in a mechanical age.

The decline in fuelwood consumption is largely a matter of changes in requirements and competition of other materials, paralleling somewhat the changes in lumber requirements. Perhaps the first great change in domestic fuel requirements came with the introduction of the base burner and coal. Without attempting to list them chronologically or to give all the other changes that have occurred, there have been the gasoline and gas stoves for cooking, the furnace or central heating plant using coal, oil, and gas; and electricity with electric appliances. That these changes are still under way is shown in the recent advances in distribution of gas made possible by welded pipe. There were over 40 thousand miles of natural-gas trunk lines in 1926.

9/ From Interstate Commerce Commission reports.

Table 28- Steam railway mileage on Clsss 1, 2, and 3 roads, by two-year periods, 1900-1928

Year	Total miles of main roads	Total track mileage	Two-year increases in mileage
1900	193,346	..	..
1902	202,472	..	..
1904	213,904	..	..
1906	224,363	..	..
1908	223,468	..	..
1910	240,293	351,767	..
1912	246,777	371,238	19,471
1914	252,105	387,208	15,970
1916	254,037	397,014	9,806
1918	253,529	402,343	5,329
1920	252,845	406,580	4,137
1922	250,413	409,359	2,779
1924	250,156	415,028	5,669
1926	249,138	421,341	6,313
1928	249,309	427,750	6,409

Considering wood as chiefly a domestic fuel, the extent of competition of other fuels is illustrated by an increase in domestic consumers of natural gas from roughly a million in 1909 to 5 million in 1929. Domestic consumption of bituminous coal increased from 55 million tons in 1909 to 98 million tons in 1927. The domestic consumption of anthracite coal was approximately 48 million tons in 1927.

It is impossible to arrive at actual displacement of wood by other fuels from information available, but the above figures are at least suggestive. At 10 tons per dwelling, the domestic coal consumption of 146 million tons in 1927 would supply fuel for nearly 15 million dwellings, or roughly the total urban dwellings. This coal consumption was supplemented by artificial and natural gas, fuel oil, and other minor fuels. The typical domestic consumer consumes more than one fuel, that is, there is an overlapping in number of consumers of coal, oil, gas, electricity and wood. Furthermore, coal, oil, and gas compete with one another just as they compete with wood.

One observation can be made, even with the incomplete data, and that is that in periods of distress or depression many consumers go back to wood. This is particularly true in rural districts. Importance of wood as a fuel is not a matter only of quantity, but insurance against necessity or adversity. And by the use of wood as fuel, the rural consumer is providing a market for one of his major crops. The figure of 61 million cords of fuelwood cut from commercial forests if valued at $4 per cord represents at least a saving, if not a return, of $244,000,000 annually to the rural districts, providing there is no better outlet for the timber. Consuming as domestic fuel the young timber which should be reserved for future industry may not be good economy.

Minor Products

As already stated, minor wood products, although they exhibit here and there a tendency to an increase in wood consumption, give no indication of exerting any preponderating influence on timber requirements as a whole. A cumulative record of consumption in veneer, poles, shingles, cooperage, excelsior, and tanning and distillation wood is given in Table 29. Special consideration of naval stores is reserved for a separate discussion.

Naval Stores

Production of turpentine and rosin is shown in Table 30. The most significant showing is the apparent recovery of production since 1925 to the level of that for the period from 1910 to 1914. This does not agree with the prospect of a declining industry suggested by statistics up to 1920.

Exports absorb around fifty per cent of our production and apparently the decline in production of naval stores after 1914 might be accounted for largely by the decline in exports. (Table 31.) Recovery of exports to nearly prewar volume has been accompanied by corresponding recovery of production.

For the years 1927 to 1929, the average exports of turpentine to Europe were 247,000 barrels, or 42,000 barrels less than the annual average for the ten years preceding the World War.10/ Countries outside of Europe have in recent years shown little variation in their consumption of spirits turpentine.

10/ From Gamble's International Naval Stores Year Book for 1930-31.

Table 29- Consumption of wood in minor products, specified years, 1900-1929

Year	Poles purchased	Shingles produced	Veneer logs (domestic)	Distillation wood	Cooperage stock					Chestnut tanning extract wood	Excelsior wood
					Tight staves	Tight heads	Slack staves	Slack heads	Hoops		
	Pieces	Thousands	M.ft.	Cords	M.pieces	M. sets	M.pieces	M. sets	M.pieces	Tons	Cords
1900	..	..	..	..	..	..	..	..	..	..	..
1901	..	..	..	..	..	..	..	..	..	..	..
1902	..	..	..	..	..	..	..	..	..	..	..
1903	..	..	..	..	..	..	..	..	..	..	..
1904	..	14,546,551	..	1,049,503	..	..	..	..	..	..	..
1905	..	15,340,909	181,146	676,739	241,193	12,959	..	..	..	..	..
1906	3,574,666	11,858,260	329,186	1,195,130	267,827	17,774	1,097,063	129,555	330,892	..	..
1907	3,283,268	11,824,475	348,523	1,282,120	385,232	27,693	1,175,977	106,074	490,570	..	..
1908	3,249,154	12,106,483	382,542	977,844	345,280	20,515	1,557,644	123,849	336,484	..	..
1909	3,738,740	14,907,371	435,981	1,265,157	379,231	20,691	2,029,548	140,234	375,793	18,527	..
1910	3,870,694	12,976,362	477,479	1,450,439	355,660	26,074	1,460,878	97,037	295,712	..	..
1911	3,418,020	12,113,867	444,886	1,221,359	357,198	30,310	1,328,968	106,407	353,215	..	142,944
1912	..	12,037,685	..	..	..	..	..	..	..	..	..
1913	..	..	..	..	..	..	..	..	..	..	..
1914	..	..	..	1,042,517	..	..	..	..	..	..	..
1915	4,077,964	8,459,378	..	..	..	..	..	..	..	..	..
1916	..	9,371,333	..	..	..	..	..	..	..	..	..
1917	..	8,696,513	..	..	..	..	..	..	..	..	..
1918	..	5,690,182	..	..	286,401	20,711	1,099,971	60,751	332,684	..	..
1919	..	9,192,704	576,581	1,442,675	353,825	24,274	1,121,324	87,381	140,772	32,526	..
1920	..	6,938,854	..	..	..	..	..	..	..	..	..
1921	..	6,843,187	400,388	482,503	255,047	20,505	893,621	66,747	137,380	..	..
1922	..	8,131,242	..	..	..	..	..	..	..	..	..
1923	3,060,794	7,506,869	645,793	1,370,120	222,507	19,342	893,682	80,477	153,954	139,107	171,077
1924	..	6,862,385	..	..	..	..	..	..	..	..	..
1925	3,281,514	7,324,027	720,865	1,276,245	240,023	23,052	937,597	71,371	149,167	104,268	187,554
1926	..	6,008,346	..	..	..	..	..	..	..	..	..
1927	3,624,833	6,443,868	943,993	1,264,721	324,127	26,445	961,782	59,337	134,596	..	178,860
1928	..	5,603,690	..	..	..	..	..	..	..	..	..
1929	4,556,895	6,110,672	1,095,244	1,327,366	357,293	30,389	1,039,450	72,591	133,054	79,531	170,604

Forest Service in cooperation with the Bureau of the Census

Table 30- Naval stores production in the United States, 1910-1929

Year 1/	Turpentine			Rosin		
	Gum	Wood	Total	Gum	Wood	Total
	Gallons	Gallons	Gallons	Barrels 2/	Barrels 2/	Barrels 2/
1910	29,750,000	750,000	30,500,000	1,970,000	14,000	1,984,000
1911	31,900,000	1,000,000	32,900,000	2,125,000	23,000	2,148,000
1912	34,000,000	1,200,000	35,200,000	2,267,000	98,000	2,365,000
1913	32,000,000	1,250,000	33,250,000	2,132,000	130,000	2,262,000
1914	27,000,000	576,000	27,576,000	1,706,000	34,000	1,740,000
1915	23,500,000	700,000	24,200,000	1,565,000	40,000	1,605,000
1916	26,750,000	1,000,000	27,750,000	1,782,000	89,000	1,871,000
1917	23,700,000	1,800,000	25,500,000	1,531,000	160,000	1,691,000
1918	17,050,000	1,300,000	18,350,000	1,115,000	123,000	1,238,000
1919	18,300,000	1,535,000	19,835,000	1,237,000	158,000	1,395,000
1920	24,450,000	1,750,000	26,200,000	1,577,000	180,000	1,757,000
1921	24,378,000	442,000	24,820,000	1,662,000	53,000	1,715,000
1922	22,395,000	1,859,000	24,254,000	1,500,000	152,000	1,652,000
1923	27,175,000	2,607,000	29,782,000	1,790,000	201,000	1,991,000
1924	26,072,000	3,261,000	29,333,000	1,721,000	258,000	1,979,000
1925	23,922,000	3,123,000	27,045,000	1,579,000	289,000	1,868,000
1926	25,500,000	3,983,000	29,483,000	1,700,000	365,000	2,065,000
1927	31,549,000	4,333,000	35,882,000	2,072,000	409,000	2,481,000
1928	28,000,000	4,323,000	32,323,000	1,865,000	432,000	2,297,000
1929	31,321,000	4,802,000	36,123,000	1,976,000	447,000	2,423,000

Bureau of Chemistry. This compilation includes trade and association estimates, which in some instances differ considerably from the figures reported to Government bureaus, especially those for wood distillation products. The differences may also be due in part to the differences in the periods covered by reports, i.e. crop years and calendar years.

1/ Crop years beginning April 1

2/ Barrels of 500 pounds

Table 31 - Turpentine and rosin: Imports and exports 1909 - 1929

Year	Imports		Exports	
	Turpentine (spirits)	Rosin	Turpentine (spirits)	Rosin
	Gallons	Barrels of 500 lbs.	Gallons	Barrels of 500 lbs.
1909 1/	50,766	22,938	17,502,028	1,215,299
1914 1/	72,679	5,484	18,900,704	1,354,052
1919	1,662	192	10,672,102	677,391
1920	43,385	283	9,458,423	652,024
1921	32,210	58	9,267,959	560,864
1922	98,550	81	9,369,403	799,174
1923	156,397	1,957	11,478,459	1,204,689
1924	177,675	1,306	11,510,154	1,452,387
1925	287,397	14,167	11,557,221	1,172,335
1926	306,586	21,114	11,586,590	1,094,322
1927	315,453	11,027	15,810,172	1,381,689
1928	342,528	4,175	13,552,888	1,174,193
1929	402,488	2,029	17,184,683	1,437,418

Compiled from "Foreign Commerce and Navigation of the United States," Volumes 1 and 2.

1/ Twelve months ended June 30 of year designated.

In 1913 the export of rosin to Europe was 1,120,000 barrels and to the rest of the world 338,000 barrels. In the 5 year period 1922 to 1926, the average annual export of rosin to Europe was 677,000 barrels, and to countries outside Europe 446,000 barrels. The gradual expansion of countries outside of Europe as users of rosin stands out clearly. This expansion was chiefly in exports to the Far East.

It would be impossible to say what European requirements will be under more stable conditions than at present or when that time will arrive. Should exports to Europe recover the prewar volume, total requirements would exceed prewar, owing to increasing exports to countries outside Europe.

While the naval-stores industry is still popularly referred to as the "turpentine industry," it is recognized that more and more the rosin product of the industry has become its financial backbone. Research agencies are seeking to discover new uses for rosin which may tend to increase its consumption. The most notable increase in the consumption of rosin in recent years has been in paper sizing. Its consumption has also increased in insulation and in manufacture of linoleum and oil cloth.

Summary

This study of timber requirements for industry does not set up requirements for 1950 or any other future time. Nor does it seem that definite forecasts can or should be made. On the other hand, consumption trends have been analyzed to illustrate how major factors in consumption may and should be determined and their relative influence established for timber products just as much as for other products of manufacture. This analysis should make it possible to better anticipate future timber requirements.

Among other things, the analysis shows why changes in agriculture have probably reduced the normal rural requirements below what they were twenty-five years ago, but by no means to the level of present consumption. The analysis also suggests that urban consumption of lumber from 1925 to 1928 was larger than should be expected with a normal volume of construction.

There is the suggestion that with a better understanding of the competitive elements, it will not only be easier to anticipate future lumber requirements, but lumber products will be better able to meet other materials in competition, which may have its effect on future requirements, and that scientific research has not had an opportunity as yet to show whether it can do for lumber what it has done in other fields.

Paper requirements have been increasing rapidly, and the factors involved are readily apparent, but as yet there is no objective or destination in view. That is, every family should have a home, and the normal requirement as to its size can be assumed, but whether every family should subscribe for one or two daily papers and whether the daily paper should be 24 or 40 pages are questions for which we have no answer.

Analysis of declining consumption of lumber, and suggestions as to how old markets may be retained, should not be interpreted to mean that lumber is passing out of the picture. Indications point to future requirements of substantial proportions regardless of competition. And the development of new products or wood requirements will be in addition to such lumber requirements rather than in lieu of them.

Mention has been made of the possibilities of not only holding present markets, but increasing the consumption of lumber. There has also been cited the growth in paper consumption and some new cellulose products as represented by rayon. The matter of new uses should, however, be considered from the broadest aspects in relation to timber requirements.

A little generalization will readily illustrate the point. The introduction of fiber boards did more than furnish competition for lumber. It made us conscious of structural insulation as of value in itself, and has created new market possibilities. The hard fiber boards and the plywood panels have demonstrated the convenience and merit of large sheets free from defect for construction and for factory use. Such boards are finding new uses all the time.

Our education on sanitation made obsolete the wood bucket and the built up lunch counter top, and introduced sanitation into flooring, but it also made possible the new markets for single service paper cup, plate and handkerchief. And new fiber composition may get on to the sanitary lunch counter or the sanitary floor.

In setting up a general requirement for materials that can be pressed into shape or molded, mass production has operated against some of the older uses for wood, but it has suggested plastic materials from wood as another field with considerable possibility.

This is all leading to a conception of wood as a material readily susceptible to transformation as contrasted to use in its original form, and this new conception itself offers unlimited prospect for new requirements.

TIMBER GROWTH

The best available data on growth - though employed, as in the following discussion, with due consideration for the composition of each type with respect to age classes, density of stocking, mixture of species, site differences, and other factors that affect the rate of growth - are insufficient to afford a basis for any precise estimates of growth rates in the various forest types. A considerable margin of error must be allowed. Nevertheless, with all due allowance for such discrepancies, it is felt that the figures given and the inferences drawn therefrom are in the main dependable.

Estimates of the present and future growth are for net increment, after allowing for so-called "normal" losses from decay, insects, etc. No allowance has been made for abnormal or unusual losses from disease or insect epidemics, fires, hurricanes, etc. These are taken care of in the estimates of drain on the forest. As in the estimates of stand and drain, the growth figures represent volume of wood without bark. The board foot volumes are on the basis of estimated mill tally, assuming

reasonably complete utilization. The growth in cubic feet on saw-timber and cordwood areas is for stem wood, including all trees 4 inches or more in diameter at breast height. It also includes the large limbs in the hardwoods.

Present Growth

The estimated current growth of material large enough for saw timber (in board feet) and of all timber of usable size, including both saw timber and cordwood (in cubic feet) are shown in Table 32.

Of the 9,740 million board feet of saw-timber growth, 6,200 million feet or 64 per cent is softwood. Of the total growth of 7 billion cubic feet, softwood comprises 54 per cent. More than one-half of the saw-timber growth and also of the total growth is in the Southeastern region, which has more than 100 million acres of growing saw timber and cordwood. The growth in the Lake States is strikingly low, owing primarily to the depletion of the stock of cordwood and saw timber. Less than one-sixth of the 56 million acres of forest land in the region bears growing saw timber or cordwood, and three-fifths may be classed as restocking areas, with young timber below cordwood size. The low figure for growth in the West, about one-seventh of the total, is explained by the fact that the forest area in this region is largely covered with over-mature timber which is making little or no net growth or with very small young timber.

There is a large potential or latent increment on the small trees below cordwood size, particularly those on the restocking areas. (Table 33.) As most of it will not become usable material until after the trees have reached at least cordwood size, its growth can not be considered as adding to the volume currently. In a similar manner the potential increment in board feet on both the cordwood and the restocking areas is large, provided it can be assumed that the timber on these areas will eventually reach saw-timber size.

Probable Growth in 1950

It is of interest to estimate what the growth may be a few years from now, say about 1950. It is, of course, impossible to predict just what may happen to modify the forest situation during the next 20 years. Any estimates of future growth can be little better than guesses, based on certain arbitrary assumptions. Although methods of handling the forest may remain generally about as at present, several changes in the situation may be expected. It is probable that fire protection will be considerably improved and that other measures tending to prevent abnormal losses and to insure reasonably prompt restocking of cutover areas will be adopted. Many of the old stands that are now producing little or no net growth will have been cut and their places taken by young stands. Few of these young stands, however, will show growth of usable material within 20 years. With better fire protection, much of the present material on restocking areas will advance to cordwood size and much of the present cordwood will become saw timber. Also, with better protection the net increment per acre on all cordwood and young saw-timber stands will be considerably larger than at present. To balance these gains, a considerable portion of the saw timber and cordwood now growing will be cut.

Table 32 - Present current annual growth on saw-timber and cordwood areas of the United States, by regions

Region	Total growth on saw-timber and cordwood areas			Growth of timber of saw-timber size		
	Total	Softwood	Hardwood	Total	Softwood	Hardwood
	Million cu. ft.	Million cu. ft.	Million cu. ft.	Million ft.b.m.	Million ft.b.m.	Million ft.b.m.
New England	390	155	235	790	430	360
Middle Atlantic	585	110	475	600	180	420
Lake	175	25	150	125	15	110
Central	1,040	80	960	865	65	800
Southeast	3,830	2,440	1,390	5,350	3,520	1,830
Pacific Coast	520	515	5	1,200	1,180	20
North Rocky Mt.	300	300	..	440	440	..
South Rocky Mt.	200	200	..	370	370	..
Total	7,040	3,825	3,215	9,740	6,200	3,540

Table 33 - Annual rate of potential growth on present restocking areas 1/

Region	Total	Softwood	Hardwood
	Million cu. ft.	Million cu. ft.	Million cu. ft.
New England	160	45	115
Middle Atlantic	185	20	165
Lake	815	125	690
Central	250	20	230
Southeast	1,070	665	405
Pacific Coast	915	910	5
North Rocky Mt.	190	190	..
South Rocky Mt.	5	5	..
Total	3,590	1,980	1,610

1/ Not now available for use because the trees are too small for cordwood.

Table 34 gives two estimates of what the current annual growth might be in 1950. One of these is based on the assumption that the annual production of lumber and cordwood will continue at approximately the same level as in 1929. If this should be the case, indications are that the area of saw timber and cordwood would in 20 years be reduced much below the present area in all of the eastern regions except the Lake States, and that the current growth of usable material would be correspondingly reduced. For the country as a whole the current growth of such material would be only about 40 per cent of the present growth. Although the total annual growth in the Southeast, including that on restocking areas, would remain about the same as at present, the growth of saw timber and cordwood would be reduced by more than 85 per cent. In the Central States the saw timber and cordwood stands would be practically wiped out, leaving a very small annual growth of usable material but a large restocking area. The Lake States would have more than double the present growth because of the large restocking areas on which the young trees would have reached cordwood size. For the same reason the growth in the Rocky Mountains would increase slightly, and that on the Pacific Coast very considerably. The three Western regions combined would apparently have half of the total current growth of usable material for the entire country. The areas of restocking land would be greatly increased in all regions except the Lake States. For the country as a whole potential growth on restocking areas in 1950 may be estimated as more than double that on the present restocking areas.

However, because of depleted supplies, if for no other reason, cutting of saw timber in the eastern portion of the United States is not likely to continue until 1950 at the 1929 rate. It has already decreased approximately one-half since 1909. Accordingly, an estimate was made based on the arbitrary assumption that the average saw timber cut between now and 1950 will be one-half of the 1929 cut for the East and equal to the 1929 cut in the West. The considerably greater volume of saw timber and cordwood thus left in the East would bring about a current growth of such material in the East almost twice as great as that shown in the first assumption; but the United States total would still be only a little more than one-half of the growth of 1930. It is estimated that the growth of saw timber alone would be about 8½ billion board feet, or almost as much as the present growth. The potential growth on restocking areas would be double the growth of usable saw timber and cordwood.

Usable Growth Affected by Age-class Distribution

The large discrepancy between current growth of usable material (saw timber and cordwood) and the total potential growth both now and in 1950, is due to the extensive areas of young timber (particularly in the East) and over-mature timber (chiefly in the West) with very low net growth or none at all. Before the forests can be put on a permanent sustained yield basis so that a volume approximately equal to the annual growth can be cut each year there will have to be fairly even distribution of age classes. This will be necessary in order that the volume of timber becoming large enough for cutting in any given period shall be approximately the same as the volume that is cut. Where there is a large surplus of mature and over-mature timber, as in the Pacific Coast region, the rate of cutting can exceed the growth for a considerable period while the surplus is being used up, without violating the principle of sustained yield. The cutting should, however, be extended over a sufficient number of years for the existing young stands to mature, and the cutover land

Table 34 - Possible current annual growth of timber in 1950 on present forest area of the United States

(A) If cutting continues at the 1929 rate in all regions			
Region	Total growth on saw-timber and cordwood areas	Growth of timber large enough for saw-logs	Potential growth on restocking areas
	Million cu.ft.	Million ft. b.m.	Million cu. ft.
New England	150	580	450
Middle Atlantic	340	650	410
Lake	390	90	775
Central	20	80	765
Southeast	490	1,150	4,300
Pacific Coast	860	1,260	1,410
North Rocky Mt.	325	370	330
South Rocky Mt.	250	450	50
Total	2,825	4,630	8,490

(B) If lumber cut in the East averages one-half the 1929 rate			
Region	Total growth on saw-timber and cordwood areas	Growth of timber large enough for saw-logs	Potential growth on restocking areas
	Million cu.ft.	Million ft. b.m.	Million cu. ft.
New England	190	740	400
Middle Atlantic	365	760	370
Lake	430	210	750
Central	120	490	725
Southeast	1,260	4,230	3,600
Pacific Coast	860	1,260	1,410
North Rocky Mt.	325	370	330
South Rocky Mt.	250	450	50
Total	3,800	8,500	7,635

should be restocked promptly so as to give a fairly regular sequence of age classes from the oldest down to the youngest. Where there is a serious deficiency in mature timber and timber approaching maturity, as appears to be true in several eastern regions, continued cutting at a rate equivalent to the total annual growth is bound sooner or later to exhaust, at least temporarily, the supply of timber that is large enough for economical utilization. In these regions it is desirable that the cut be held somewhat below the current growth, until the deficiency in the middle and older age classes is made up. As indicated by Table 34, the continuous cutting at the present rate, if distributed regionally as at present, would be likely not only to result in a serious gap in age classes, but also in a still more unsatisfactory distribution of these classes than at present and a corresponding reduction in usable increment.

Possible Growth under Sustained Yield Management

Estimates of probable current forest growth in 1950 are illuminating in some particulars, but in other respects are unsatisfactory. For one thing, they give no opportunity, because of the shortness of the period involved, to judge of what might be looked for under forest practice of different degrees of intensity. In 20 years, no matter how intensive the degree of forest management, any attempt to work out an even distribution of age classes would be utterly hopeless. To do this would take, at the very least, one tree generation. Possibly by the year 2000, provided the forests were handled under rotation periods long enough to produce cordwood and saw timber, it might be possible to bring about such an arrangement of age classes that the aggregate current annual growth would equal the volume of the age class suitable for cutting in each year. This is, of course, only a theoretical possibility, and the purpose of working out estimates on this basis for the year 2000 is not at all to prophesy what may be expected either then or later, but rather to develop a concept of possible forest growth under different conditions that, even though it be inaccurate as to volume of growth attainable or period required in which to attain it, will serve in some measure to throw the present situation into its proper perspective.

In Table 35 are presented estimates of the annual timber growth in the various regions in the year 2000 under two different degrees of forest management - "crude" and "intensive."

Under crude forestry it is assumed that all of the forests would be in growing condition, that all of the overmature stands would have been cut and that all of the cutover areas would be restocked so far as this would come about naturally, without planting, but with adequate provision for seed trees, and that damage from forest fires would be reduced to a minimum. The total annual growth under these conditions is estimated at approximately 19 billion cubic feet or an average of about 38 cubic feet per acre. Almost one-half of this would be in the Southeast, and about one-sixth in the Pacific Coast region.

Under intensive forestry, it is assumed that all of the area would be in a growing condition and well stocked with desirable species adapted to each site, that damage from fire and grazing would be practically eliminated, and that cultural measures would be generally practiced both to utilize the trees that under present conditions are lost from decay, suppression, etc., and to create the best growing conditions for the remaining trees.

Table 35 - Possible current annual growth of timber in the year 2,000 on present forest area of the United States

Region	Growth with crude forestry	Growth with intensive forestry
	Million cu.ft.	Million cu. ft.
New England	890	1,670
Middle Atlantic	1,040	1,660
Lake	1,750	3,000
Central	1,930	3,120
Southeast	9,100	14,000
Pacific Coast	3,060	4,880
North Rocky Mt.	930	1,370
South Rocky Mt.	430	730
Total	19,130	30,430

The growth under intensive forestry, which is estimated at more than 30 billion cubic feet or 61 cubic feet per acre, represents the maximum increment that our present forest areas are capable of producing under reasonably intensive management. As such it amounts to an ideal figure, rather than a result that could be expected at any future date. What may actually be accomplished in the next 60 to 70 years, by the most optimistic estimate, will barely equal the estimate for crude forestry in Table 35. Indeed, usable growth as large as that estimated for crude forestry can not be attained unless definite efforts are made to increase the growing stock.

Growing Stock required for Sustained Yield of Usable Timber

Now that we are approaching measurably nearer the end of the supply of ready-grown, mature timber the problem of maintaining an adequate growing stock becomes of great importance.

After the 200 to 400 year old trees from which the bulk of our saw timber now comes have all been removed, the saw timber cut in any region must come mostly from trees 60 to 150 years old. This time is near at hand in several regions. Some saw timber is being cut from trees younger than 60 years but the cost of logging such timber is generally high and the quality of the product low. Following the removal of the reserve of old trees in any region the oldest trees of the present immature growing stock will be cut, then the next oldest, and so on from age class to age class. If natural or artificial regeneration regularly follows the cutting of the older trees and is not destroyed by fire or otherwise, the stands tend to become arranged in age classes ranging from newly established seedlings up to stands ready for cutting. If the average size for cutting is reached in approximately 60 years, an ideally managed forest might be thought of as containing 60 1-year age classes, the oldest of which is cut each year. Actually, damage from fire, insects, etc., and the variation in success of natural regeneration prevent such regularity, and the best succession attainable would probably be in the form of six 10-year groups. The oldest group would then supply the cut for the first 10 years. Meanwhile the next group would have reached the age for cutting and each of the other groups would have aged 10 years. Such a forest contains the minimum growing stock that can supply a continuous cut equivalent to the annual growth on the whole area, without cutting for timber any trees below the rotation age.

Several estimates of the growing stock that would presumably have to be maintained in order to assure a sustained yield of saw timber are shown in Table 36. For purposes of computation, it is assumed that all eastern regions will grow trees to the average age of 60 years, although as a matter of fact, trees must be grown considerably older than 60 years in many types of eastern forest in order to produce a good grade of timber. In the western regions a minimum of 100 years is assumed. In the redwood and Douglas fir types shorter rotations may be adopted, but in the Rocky Mountains and in the drier portions of the Pacific Coast States 100 years is really insufficient.

If the second-growth forests were to be handled on short rotations, the result would be the production of a very large quantity of material suitable for such products as fuel, pulpwood, posts, and low-grade lumber, of which in most parts of this country there is even now an excess. For some types of forest in some localities

Table 36 - Forest growing stock required for sustained timber yield, by regions

Region	Present stand of saw-timber and cordwood	To maintain present cut			To maintain cut equal to growth under crude forestry in the year 2000			To maintain cut equal to growth under intensive forestry in the year 2000	
		Stock required	Present surplus	Present deficit	Stock required	Present surplus	Present deficit	Stock required	Present deficit
	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.	Billion cu. ft.
New England	23	17	6	..	24	..	1	45	22
Middle Atlantic	21	21	..	..	28	..	7	44	23
Lake	21	34	..	13	46	..	25	80	59
Central	29	55	..	26	51	..	22	83	54
Southeast	106	171	..	65	243	..	137	373	267
Total eastern regions	200	298	..	98	392	..	192	625	425
Pacific Coast	190	141	49	..	147	43	..	234	44
North Rocky Mt.	45	14	31	..	45	..	..	66	21
South Rocky Mt.	33	6	27	..	20	13	..	35	2
Total western regions	268	161	107	..	212	56	..	335	67
Total United States	468	459	9	..	604	..	136	960	492

production of pulpwood and other small material on fairly short rotations may be the best form of management. For most forests, however, the best results from both the economic and the silvicultural standpoints will probably be attained under rotations long enough to yield saw timber. When forests are so managed a large proportion of all the wood produced will be of saw timber size and ordinarily will bring the highest price per unit of volume. The remainder of the wood, coming from tops of saw-timber trees or cut at intervals from thinnings in the growing stands, can ordinarily be counted on to supply most of the small material that is needed.

The required growing stock as shown in Table 36 has been computed on three different bases as follows:

(1) The growing stock that would be required to maintain the present timber cut (both saw timber and cordwood) in each region, assuming that there will be no further abnormal losses from fire, disease, etc.

(2) The growing stock that would be required for a sustained cut of saw timber and cordwood equal to the growth theoretically attainable under crude forestry by the year 2000, as shown in Table 35.

(3) The growing stock that would be required for a sustained cut of saw timber and cordwood equal to the growth that is estimated to be attainable under intensive forestry, as given in Table 35.

The above computations indicate that if the United States could be considered as a unit and the cut properly allocated between regions, the total existing growing stock of saw timber and cordwood would be just about sufficient to maintain the present rate of cutting. No allowance, however, is made in these calculations for the continued reduction in growing stock as a result of abnormal losses from fire, disease, insects, storm, etc. Some losses from these agencies must be expected even under intensive forestry practice. Because of this, and even more because of the impracticability of reallocating the cut quickly, the existing growing stock is already inadequate.

If we look at the individual regions the situation appears to be far from satisfactory. The Middle Atlantic region apparently has sufficient growing stock for the present rate of cutting and New England a slight surplus. The Lake States, the Central States, and the Southeast fall far short of having enough to maintain the present rate of cutting even if liberal allowance is made for possible underestimates of the present timber stand in these regions. The East as a whole apparently has only two-thirds of the growing stock needed to maintain the present cut even with an average rotation as short as 60 years. A longer rotation would, of course, require a larger growing stock. The inevitable result of this is that sooner or later there will be a decline in the volume of the cut. Such a decline in the rate of cutting can be postponed, but only for a short time, by a constant reduction in the size of the timber that is cut until the stock of saw timber is exhausted and the forests yield only cordwood. No eastern region has enough growing stock for a sustained cut equal to the growth that is estimated to be possible under crude forestry. The East as a whole would have practically to double its present stand of timber in order to maintain such a cut and would have to treble the present stand before it

could produce a sustained yield as large as that estimated to be possible under intensive forestry.

In the West the situation appears to be different. According to the same method of computation that was applied to the Eastern regions, all of the Western regions still have a considerable surplus timber stock over that required to sustain the present cut on a 100 year rotation. On this basis one-fourth of the existing stand on the Pacific Coast is surplus and three-fourths of the stand in the Rocky Mountain region. If a rotation shorter than 100 years should be adopted for Pacific Coast Douglas fir and redwood, the surplus in that region would appear even larger. The indication is that, although the present rate of cutting is much larger than the current growth, cutting can be continued at the present rate or may even be increased somewhat until the surplus of mature timber is reduced. The Western timber supply is even larger than is needed to maintain a cut equal to the estimated growth under crude forestry, if abnormal losses are not taken into account; but there is 20 per cent less than would be needed for intensive forestry. The situation in the West is complicated by the fact that a large proportion of the timber is in national and other public forests where the present rate of cutting is very much lower than the sustained yield possibility, whereas the rate of cutting on a large proportion of the privately owned forests is greater than can be maintained with the existing growing stock. This means that in the long run the Western cut from private forests will decrease and the cut from public forests will gradually increase.

What must be done to Maintain and Increase the Productive Capacity of our Forests?

The conclusion that may fairly be drawn from the above figures is that a considerable decline in the timber output of certain regions is inevitable. Indeed, unless there is a radical readjustment of production between the various regions and even within regions, it will be impossible to avoid at least a temporary reduction in the national timber output.

The extent of the decline in regional and national production, and whether it is to be permanent or only temporary in character will depend upon the measures that may be adopted for building up and maintaining an adequate growing stock of timber. It is evidently desirable that cutting in certain forest types and regions should be reduced so as to give the young stands a chance to build up a growing stock. In other types or regions cutting may proceed at a more rapid rate than at present in order to replace non-growing with growing stands.

Inasmuch as practically all the timber cut in the West comes from stands that are putting on little net increment, a reduction in the cut there would have but little appreciable effect on the volume of usable growth in 1950. Although the western regions, if considered as units, have sufficient mature timber to allow continuation of cutting somewhat in excess of the present (1929) rate, this is not true of all localities within these regions. Even in the West, therefore, considerable shifting and reallocation of cutting operations will be necessary. In the East, on the other hand, a reduction in the cut during the next few decades would result in a large increase in usable growth and particularly in saw timber growth. This is especially important in the case of the Southeastern pine region and also in the Central and Lake States.

Curtailment of production in any locality is bound to cause a certain amount of hardship to the dependent industries and communities. Unnecessary curtailment should be avoided, and unavoidable curtailment should, if possible, take place gradually instead of abruptly. There are several things that can be done to lessen the necessity for reducing the cut and to slow up the process of such curtailment as may be necessary. The rate of depletion of growing stock can be reduced by eliminating preventable losses from fires, decay, insects, and windfall. Better utilization methods, more efficient marketing, and the accompanying reductions in waste would make it possible to cut a given quantity of usable products from a smaller volume of timber. Considerable material could be cut from the small or defective trees which under present conditions drop out of the stands without being utilized. The volume of usable growth could be increased also by careful selection of the stands to be cut and selection of the trees to be cut within those stands where selection methods can be applied. Wherever silvicultural and economic conditions permit, a good stand of thrifty young and middle-aged trees should be left on cut-over lands. Those stands and trees should be cut which offer no prospect of making a good rate of growth in volume or value and those should be left which promise to increase rapidly in volume or value in the comparatively near future. Through various silvicultural operations it would be possible to increase the proportion of fast growing or otherwise desirable species and to maintain that density of stand which is most favorable to rapid growth of usable timber.

Even though a temporary curtailment of cutting appears to be unavoidable in some regions, this will not necessarily be permanent. Provided economic conditions make it desirable, careful management of existing forests, reforestation of denuded lands, and adjustment of cutting to the growth capacity of the forests may result in building up a growing stock that will make possible a sustained cut greater than the present cut.

This will be a very slow process. It involves many silvicultural and economic factors concerning which much remains to be known. This knowledge can be gained only through a long-time program of research in silviculture, forest products utilization, forest economics, and related fields such as entomology, pathology, and plant and animal ecology. Even if economic conditions justified intensive forest management on all of the forest land of the United States, and if all of it were in the hands of owners willing and able to manage it intensively, many years would be required to build up the growing stock needed for sustained yields as large as those indicated in the last column of Table 35. It is very doubtful whether a permanent sustained yield larger than the average cut of the last ten years could be attained in much less than 100 years.

As a matter of fact, it is well understood that intensive management of the entire forest area is not economically practicable or likely to be undertaken in the near future. Obviously, then, there is no reason to fear overproduction of timber. There is reason to fear underproduction unless the best methods that can be devised are employed in handling the better lands at least, and unless the remainder of our forests are kept reasonably productive.