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SECOND-GROWTH YIELD, STAND, AND VOLUME TABLES FOR THE WESTERN WHITE PINE TYPE

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INTRODUCTION

The western white pine type is the most important forest unit over large areas of rough uplands in northern Idaho and adjacent portions of eastern Washington and western Montana. It occupies throughout this region the cooler, moister sites between elevations of 2,000 and 5,500 feet, reaching its best development in northern Idaho between the international boundary and the Lochsa River (*10*).[1] The type is distinguished by its luxuriant growth and great complexity and characterized by the presence of western white pine (*Pinus monticola* D. Don) in association with a large number of other species, principally western red cedar (*Thuja plicata* D. Don), western hemlock (*Tsuga heterophylla* (Raf.) Sarg.), lowland white fir (*Abies grandis* Lindl.), western larch (*Larix occidentalis* Nutt.), and Douglas fir (*Pseudotsuga taxifolia* (Lam.) Britt.).

These mixed forests constitute a very desirable natural resource. The stands are unusually dense and the timber yields are large. Moreover, the western white pine and one associate, western red

[1] Italic figures in parentheses refer to Literature Cited, p. 66.

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cedar, furnish special-use woods of high value. As a result the lumber and allied timber industries in northern Idaho and adjacent timber centers have been built up very largely around the white pine type. These forest industries are locally of great economic importance. In Idaho, for example, where they rank first among the manufacturing industries, they are valued at $100,000,000 and produce annually materials worth $41,000,000; they employ some 18,000 persons and have an annual pay roll of over $22,000,000; and the freight revenue derived from these industries amounts to nearly $11,000,000 a year, an important item in the budgets of the rail carriers of this section (*12*). In addition, the materials produced represent the crop value of some 10,000,000 acres of land in northern Idaho alone, 3,000,000 acres of which is in the western white pine type. This land, because of surface features and climate, is largely unsuited to the production of other crops. In view of these facts the maintenance of forest industries is unquestionably essential to the economic prosperity of northern Idaho and adjacent Washington and Montana.

Future yields of western white pine depend largely upon the control of the white pine blister rust. However, results already obtained from the large-scale experimental control work carried on in the western white pine forests give ample reason to believe that adequate protection from the disease can be realized where such measures are feasible.

Therefore, in view of the rapid depletion of the virgin timber stands on which these forest industries rely (*9*), it becomes increasingly important to know the timber-producing capacity of the large areas of second-growth stands to which the region must turn for raw material within the next half century. It is the purpose of this bulletin to sum up for forest managers and timberland owners the available information on the growth and yield of second-growth western white pine stands. To simplify presentation, the first part of the bulletin contains only the discussion necessary for a proper understanding and application of the tables. Essential supplementary discussion has been relegated to the appendix.

DEFINITIONS OF TERMS USED

The following definitions explain the technical and semitechnical terms used in describing the yield tables.

Diameter breast high.—Diameter at 4.5 feet above the average ground level. Commonly abbreviated as d. b. h. As used in connection with standing trees, this means diameter outside bark.

Basal area.—The basal area of a tree is the area in square feet (including bark) of a cross section taken 4.5 feet above the average ground level. The basal area of a stand is the sum of the cross-sectional areas of the trees composing it. Basal-area values for trees of various diameters are easily obtained from published tables.

Total age.—The age of the oldest dominant tree. This will coincide in most cases with the period elapsed since fire, logging, or other agency removed the previous timber stand.

Even-aged stands.—Stands in which the ages of the youngest and oldest trees are within 20 years of the same age.

Stocking.—The degree to which an area is effectively covered with living trees. Fully stocked or normal stands contain as many trees per acre as can properly utilize the growing space available.

Composition.—The mixtures of tree species forming the stand. Western white pine stands often contain from four to six tree species in widely varying combinations and proportions.

Dominant.—In this study any tree with well-formed crown that receives full sunlight from above and at least some light from the sides. It includes both dominant and codominant as ordinarily defined (*8*).

Site quality.—The relative wood-producing capacity of a given area measured in this study by the height growth of the dominant white pines (*6*).

Site index.—The height attained by the average dominant at 50 years, as a measure of site quality.

Mean annual increment.—The average yearly increase per acre in the volume of a stand, computed by dividing its total volume by its age.

Periodic annual increment.—The average yearly increase in volume per acre over a short period—in this case 10 years.

Utilization standards.—Cubic-foot volumes include the total wood contents of the entire peeled stem, comprising stump and tip but not limbs and bark, for all trees 0.6 inch d. b. h. and larger. Board-foot volumes by the Scribner rule allow for a minimum top diameter of 6 inches for white pine and 8 inches for other species, a stump height of 1 foot for white pine and 1.5 feet for other species, and a trimming allowance of 0.25 foot for white pine and 0.3 foot for other species for each 16-foot log length. Board-foot volumes by the international rule (⅛-inch saw kerf) allow for a minimum top diameter limit of 5 inches and for the same allowance for stump height and trimming as with the Scribner tables. Yield-table volumes are always given in full scale, no allowance being made for possible loss in defect, breakage, or incomplete woods utilization.

Yield.—The wood content per acre measured in some standard unit, such as cubic or board feet. The yields given in these tables are for fully stocked stands and show gross volumes, no allowance being made for defect, loss in breakage, or lack of complete utilization.

DISCUSSION OF YIELD TABLES

BASIS AND SCOPE

The yield tables in this bulletin give the number of trees, the average size of tree, the rate of growth, and the quantity of wood per acre at different ages and qualities of site for even-aged, fully stocked western white pine stands. They are the result of a study begun by the Forest Service in 1909–1912 [2] and reinitiated and completed in 1924–1926 by the Northern Rocky Mountain Forest Experiment Station. In this study the yields of fully stocked, even-aged western white pine stands between 20 and 160 years of age were measured on 306 small sample areas scattered throughout the western white pine type. Figure 1 shows the geographical distribution of these plots. On each sample area the age of stand, site quality, number and size of trees, and quantity of wood in both cubic and board feet were carefully determined. These values were then grouped and averaged

[2] Under the direction of F. I. Rockwell and A. O. Benson. Data on 31 per cent of the plots used were collected by Rockwell, and data on 10 per cent were collected by Benson in the 1909–1912 work.

to show the yields per acre common to each age-site condition. The field and office methods employed in this work have been outlined in

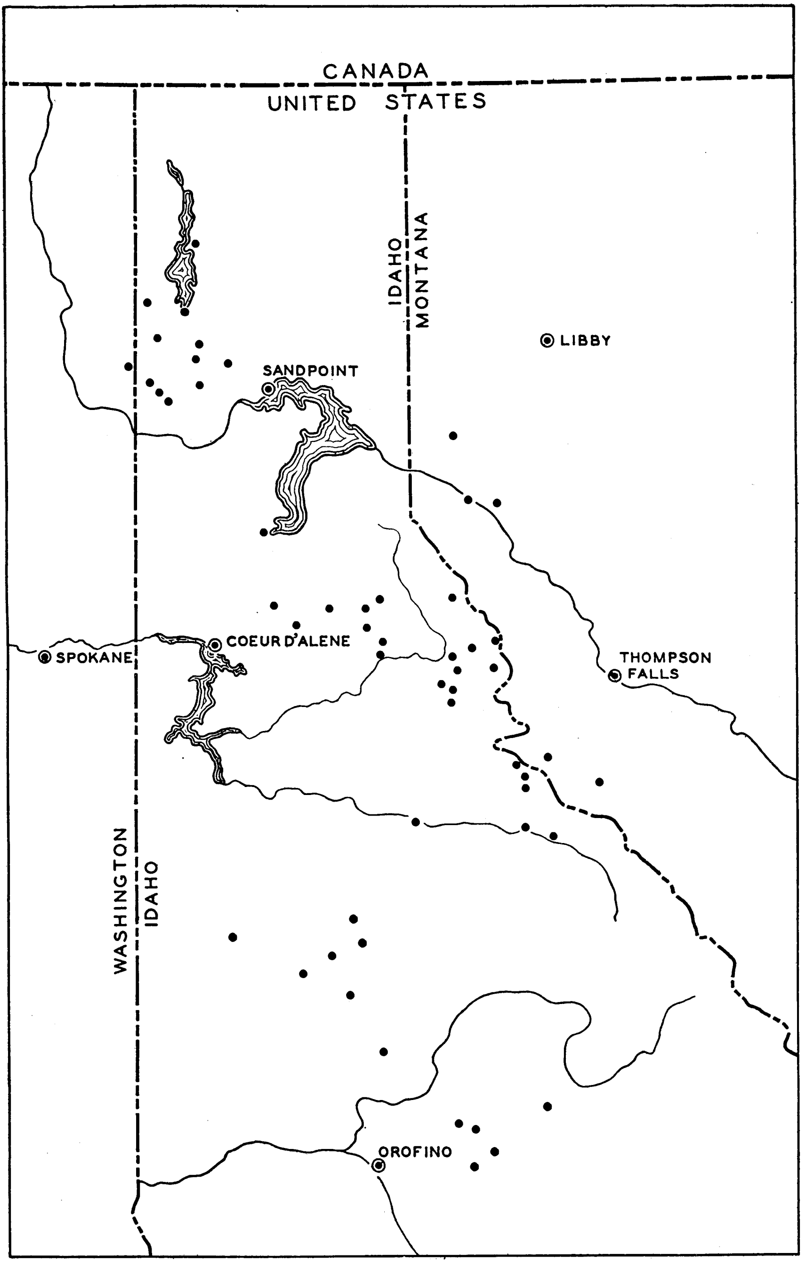

FIGURE 1.—Map showing location of sample plots; each dot marks a locality where one or more plots were taken

detail by other investigators (*15*, *2*) and need not be further elaborated here.

The resulting yield tables are applicable to western white pine stands throughout the entire region described, local differences in rates of growth and yield being accounted for in site-quality differences. The tables are also applicable throughout the region to any stand containing 15 per cent or more of western white pine. Full recognition has been accorded the fact that white pine grows only rarely in pure stands and quite commonly in mixed stands of great complexity and that there is some tendency for certain combinations of species to produce higher or lower yields than other combinations. Nevertheless, these trends are largely obscured by other factors, and a thorough mathematical analysis indicates that the tables presented are, within reasonable limits, applicable to all even-aged western white pine stands regardless of their composition. The tables are directly applicable, however, only to fully stocked stands; i. e., stands with as many trees as can properly utilize the growing space and which are without blanks or holes in the forest canopy. In applying the tables to stands other than fully stocked, the tabular values must be adjusted after the manner described on a subsequent page.

WESTERN WHITE PINE YIELDS

Tables 3 to 24, presented hereafter, constitute a complete set of yield tables, of which Tables 3 to 7 present values for the entire stand; i. e., for all trees in and above the 1-inch diameter class. The remaining tables list partial stand values, or yields per acre for all trees in and above the 7, 8, and 13 inch diameter classes, respectively, and for the dominant stand (all dominant and codominant trees). Each table shows values for one item, for example, number of trees for all age-site conditions. A summary of the values of chief interest is given in Table 1. One of the most interesting features brought out in this table is the characteristic density of fully stocked western white pine stands as indicated by the large number of trees per acre and the relatively small size of the average tree. Note also the rapid growth, averaging on good sites at 120 years some 116 cubic or 760 board feet (international rule) per year, and giving at maturity gross board-foot yields of over 90,000 board feet per acre on good soils over small acreages.

TABLE 1.—*Yields per acre, fully stocked western white pine stands*

POOR SITE—INDEX 40

Total age (years)	Height of average dominant	All trees 0.6 inch plus	Average d. b. h. of trees 0.6 inch plus	Basal area, trees 0.6 inch plus	Total volume				Average yearly growth			
					Trees 0.6 inch plus	International ⅛-inch rule		Scribner rule, trees 12.6 inches plus	Cubic-foot, trees 0.6 inch plus	International ⅛-inch rule		Scribner rule, trees 12.6 inches plus
						Trees 6.6 inches plus	Trees 12.6 inches plus			Trees 6.6 inches plus	Trees 12.6 inches plus	
	Feet	*No.*	*Inches*	*Sq. ft.*	*Cu. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
20	10	11, 500	0. 8	45	240				12			
40	30	5, 600	2. 2	146	1, 890	500			47	12		
60	49	3, 020	3. 6	215	4, 210	7, 500	50	50	70	125	1	1
80	66	1, 830	5. 1	257	6, 500	21, 600	3, 200	2, 300	81	270	40	29
100	79	1, 220	6. 5	286	8, 420	38, 000	11, 000	8, 300	84	380	110	83
120	88	980	7. 6	306	9, 980	51, 000	21, 000	16, 000	83	425	175	133
140	94	910	8. 1	323	11, 000	59, 200	28, 100	21, 000	79	423	201	150
160	98	890	8. 3	338	11, 650	63, 600	31, 700	24, 300	73	398	198	152

TABLE 1.—*Yields per acre, fully stocked western white pine stands*—Continued

Total age (years)	Height of average dominant	All trees 0.6 inch plus	Average d. b. h. of trees 0.6 inch plus	Basal area, trees 0.6 inch plus	Total volume: Trees 0.6 inch plus	Total volume: International ⅛-inch rule, Trees 6.6 inches plus	Total volume: International ⅛-inch rule, Trees 12.6 inches plus	Total volume: Scribner rule, trees 12.6 inch plus	Average yearly growth: Cubic-foot, trees 0.6 inch plus	Average yearly growth: International ⅛-inch rule, Trees 6.6 inches plus	Average yearly growth: International ⅛-inch rule, Trees 12.6 inches plus	Average yearly growth: Scribner rule, trees 12.6 inches plus
	Feet	*No.*	*Inches*	*Sq. ft.*	*Cu. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Cu. ft.*	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*
FAIR SITE—INDEX 50												
20	12	7, 800	1. 0	46	320	----	----	----	16	----	----	----
40	38	3, 650	2. 7	148	2, 270	1, 900	----	----	57	48	----	----
60	61	2, 000	4. 5	218	5, 050	13, 700	1, 000	700	84	228	17	12
80	82	1, 230	6. 2	260	7, 750	33, 300	8, 400	6, 500	97	416	105	81
100	99	820	8. 0	289	10, 100	54, 300	25, 000	19, 200	101	543	250	192
120	110	660	9. 3	310	12, 000	70, 300	44, 100	32, 200	100	586	268	368
140	117	610	10. 0	327	13, 250	80, 400	55, 600	41, 000	95	574	397	293
160	122	590	10. 3	342	14, 000	85, 900	60, 200	45, 500	88	537	376	284
GOOD SITE—INDEX 60												
20	14	4, 700	1. 3	46	400	----	----	----	20	----	----	----
40	45	2, 210	3. 5	149	2, 650	4, 400	----	----	66	110	----	----
60	73	1, 190	5. 8	221	5, 880	23, 300	5, 000	3, 700	98	388	83	62
80	98	720	8. 2	263	9, 000	48, 700	24, 100	17, 900	112	609	301	224
100	118	480	10. 5	292	11, 850	73, 500	54, 000	40, 300	118	735	540	403
120	132	390	12. 2	314	13, 950	91, 200	76, 300	59, 000	116	760	636	492
140	141	355	13. 1	331	15, 400	102, 700	90, 300	70, 500	110	734	645	504
160	146	345	13. 6	346	16, 350	109, 900	98, 900	76, 900	102	687	618	481
EXCELLENT SITE—INDEX 70												
20	16	2, 800	1. 7	47	470	----	----	----	24	----	----	----
40	53	1, 370	4. 5	151	3, 030	8, 300	600	400	76	208	15	10
60	86	760	7. 4	223	6, 710	33, 800	13, 400	10, 300	112	563	223	172
80	115	450	10. 4	266	10, 350	63, 500	46, 000	34, 600	129	794	575	432
100	138	300	13. 5	296	13, 500	90, 500	81, 000	63, 200	135	905	810	632
120	154	235	15. 7	318	15, 900	109, 400	103, 300	81, 000	132	912	861	675
140	164	220	16. 7	335	17, 500	121, 300	116, 100	91, 600	125	866	829	654
160	171	215	17. 2	350	18, 450	128, 600	123, 600	96, 800	115	804	772	605

HEIGHT GROWTH AND SITE INDEX

Figure 2 portrays the trend of average dominant height over age. These curves are based on the growth of dominant western white pines only. On good sites (site index 60) white pine dominants average about 1 foot a year in height growth in stands between 40 and 140 years of age. The dotted lines in Figure 2 indicate the limits of each site-index group at any age between 20 and 160 years in terms of average dominant height.

The site indices used in the present study are merely more exact expressions of the following general descriptive terms not capable of exact definition:

	Site index
Very best or excellent (Site I)	80–70
Good (Site II)	60
Fair (Site III)	50
Poor (Site IV)	40
Very poor (Site V)	30

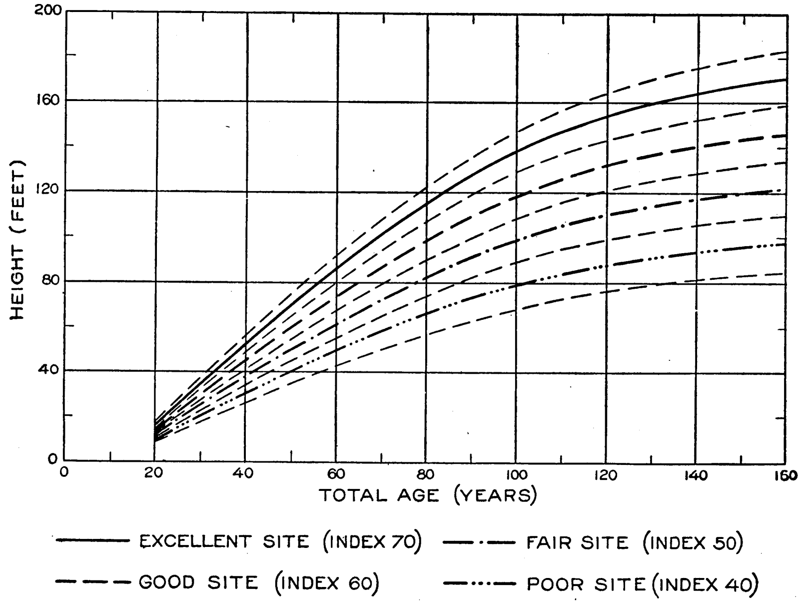

FIGURE 2.—Height curves for average dominant and codominant western white pine

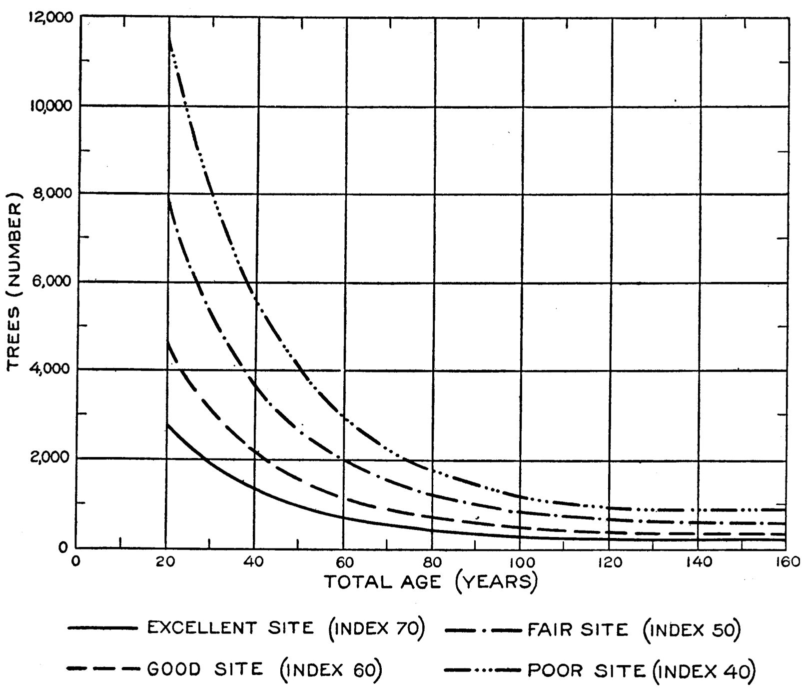

FIGURE 3.—Curves for total number of trees per acre 0.6 inch d. b. h. and larger

NUMBER AND SIZE OF TREES

Figure 3 depicts the total number of trees 0.6 inch d. b. h. and larger. The extremely rapid decrease in number of trees with increasing age is strikingly apparent. On good sites (site index 60) the total number of trees per acre drops from 4,700 at 20 years to 720 at 80 years, and to 390 at 120 years. The number of trees also decreases rapidly with increase in site index. On poor soils (site index 40)

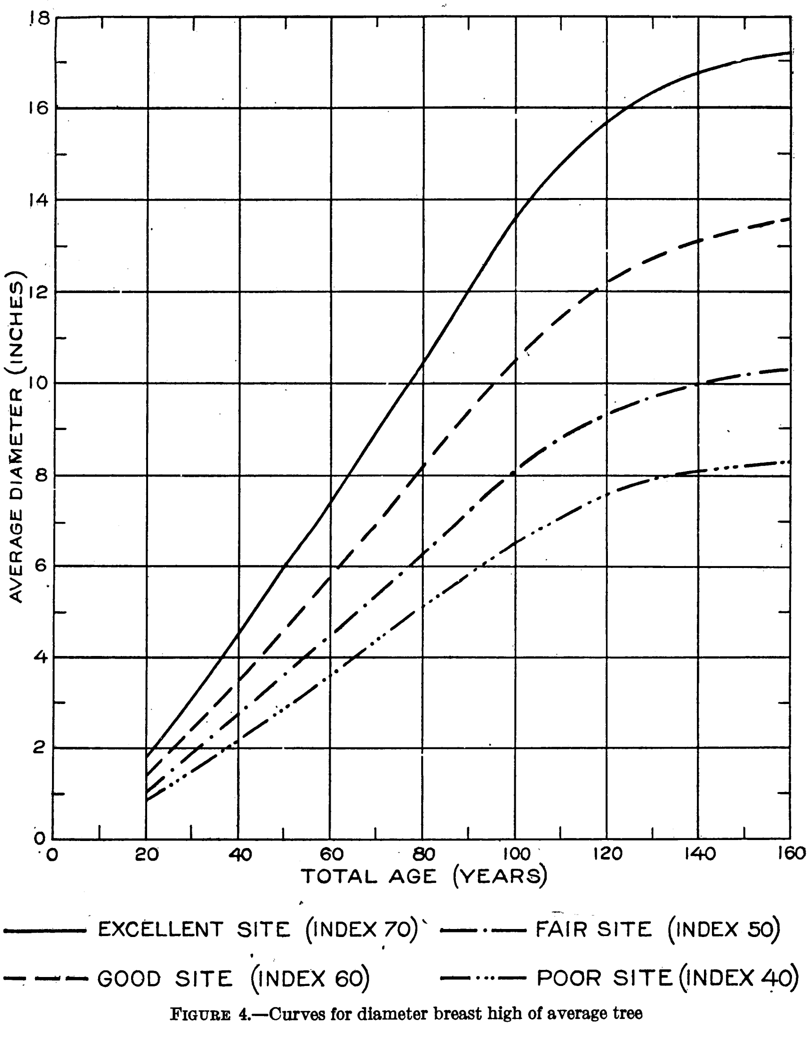

FIGURE 4.—Curves for diameter breast high of average tree

white pine stands average about 980 stems per acre at 120 years, and on excellent soils (site index 70) about 235 stems at the same age. The occurrence of more trees per acre on poor sites than on good sites in natural stands beyond the seedling stage is typical of all forest types so far investigated both here and abroad. The number of tree values given in the tables, however, must be considered little better than approximations, as the total number of trees per acre is extremely variable in western white pine stands. Occasionally the usual tendency is reversed, and individual stands on good sites contain more trees than stands of the same age on poor sites, and commonly the number of trees on individual plots differs greatly from the average values given in the table.

The size of the tree of average basal area for various age-site conditions is shown in Figure 4. In general, the trees in fully stocked western white pine stands run very small. On good sites at 120 years, for example, the average tree is only 12.2 inches d. b. h. At this age on good sites some 27 per cent of the trees are still under 7 inches d. b. h. and about 60 per cent still under 13 inches d. b. h.

CUBIC-FOOT VOLUMES

Figure 5 portrays the total wood produced, including stump and tip, but not bark, in all trees 0.6 inch d. b. h. and larger. Density

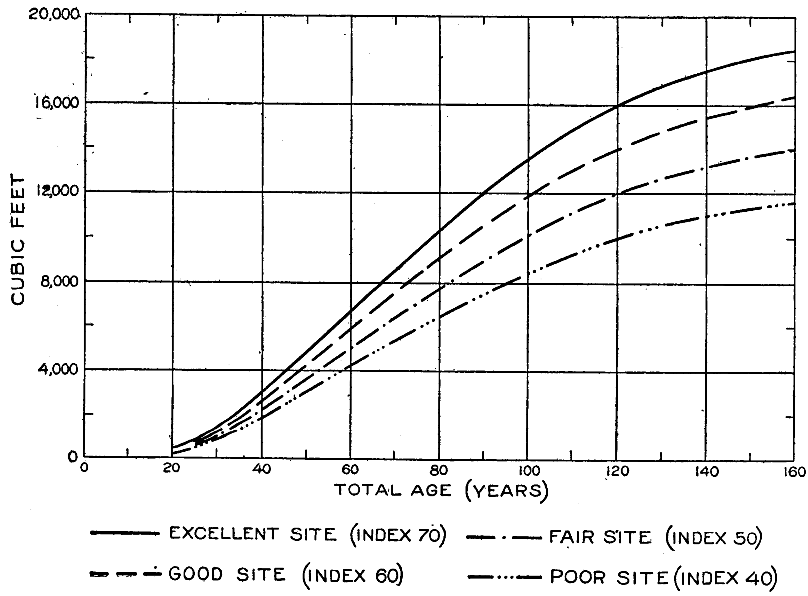

FIGURE 5.—Curves for total cubic-foot volume per acre, excluding bark

of stand and rapidity of growth both contribute to produce high cubic-foot volumes. The average fully stocked stand on site index 60 produces close to 14,000 cubic feet of wood at 120 years.

BOARD-FOOT VOLUMES

TREES IN AND ABOVE THE 7-INCH-DIAMETER CLASS

Figure 6 shows the total board-foot contents produced in fully stocked stands. These yield values include the volume of every tree 6.6 inches d. b. h. or larger that will furnish at least one 16-foot log with a 5-inch top diameter. The international (⅛-inch) rule according to which the yields are estimated is the most satisfactory log rule for estimating the board-foot content obtainable by complete utilization and with good sawing practice. The timber-producing capacity of western white pine stands is strikingly apparent in the total board-foot tables, the average fully stocked stand producing about 90,000 board feet (international rule) at 120 years on good sites. Yields of this character are not obtainable, of course, over large areas in natural stands in which yields are reduced by blank spaces and irregularities in the stand, defect, and lack of complete utilization to the limits shown in the tables. Natural openings, resulting from lack of seed, snow breakage, insect attack, and similar phenomena, all reduce yields. In addition, the tables are constructed to show gross yields; i. e., the content of every tree above a given

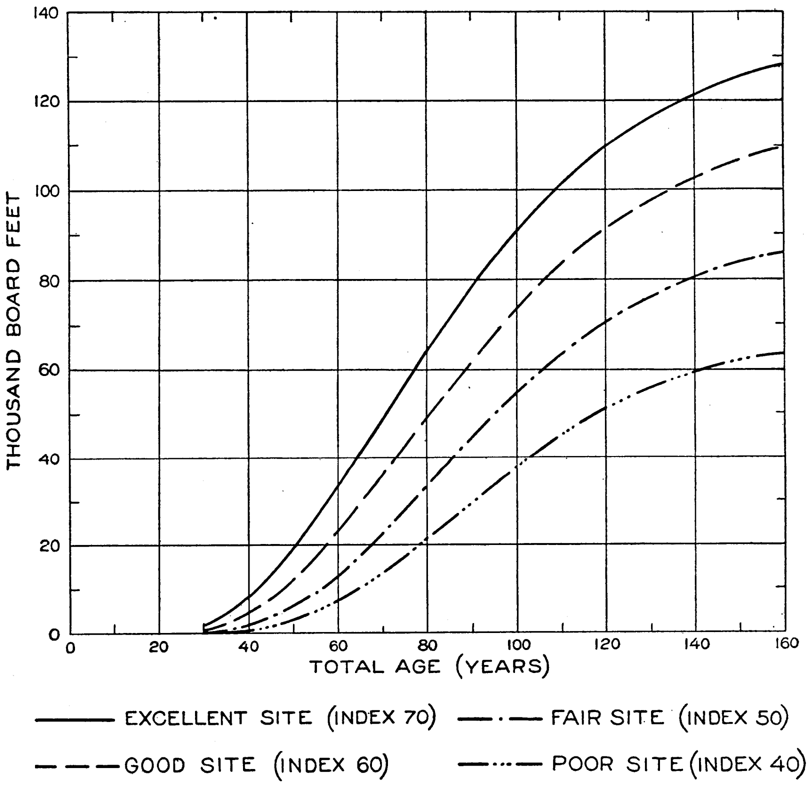

FIGURE 6.—Curves for total board-foot volume per acre, international rule (⅛-inch saw kerf), trees 6.6 inches d. b. h. and larger

diameter limit regardless of species and defect. Under present logging practices, however, a considerable amount of material is invariably left in the woods in the form of small trees and trees that are defective or unmerchantable on account of their low market value. These factors must all be considered when comparing the total yields shown in Figure 6 with present stands and the cut from areas now being logged. Extensive cruises indicate that well-stocked western white pine stands, exclusive of the larger nonstocked areas such as natural meadows and nonreproducing burns, average about 70 per cent by basal area of the values listed in the yield tables (according to unpublished data compiled by C. R. Watson and Donald Bruce, 1928). On several national-forest timber-sale areas approximately such volumes have been cut.[3]

TREES IN AND ABOVE THE 13-INCH-DIAMETER CLASS

Figure 7 depicts the board-foot yields by the international (⅛-inch) rule in all trees 12.6 inches d. b. h. and larger. Fully stocked stands on good sites at 120 years contain about 76,300 board feet per acre in trees 12.6 inches d. b. h. and larger, scaled to a 5-inch top diameter. Note in Table 1 the material differences between the international and Scribner values for trees 13 inches and up. These discrepancies

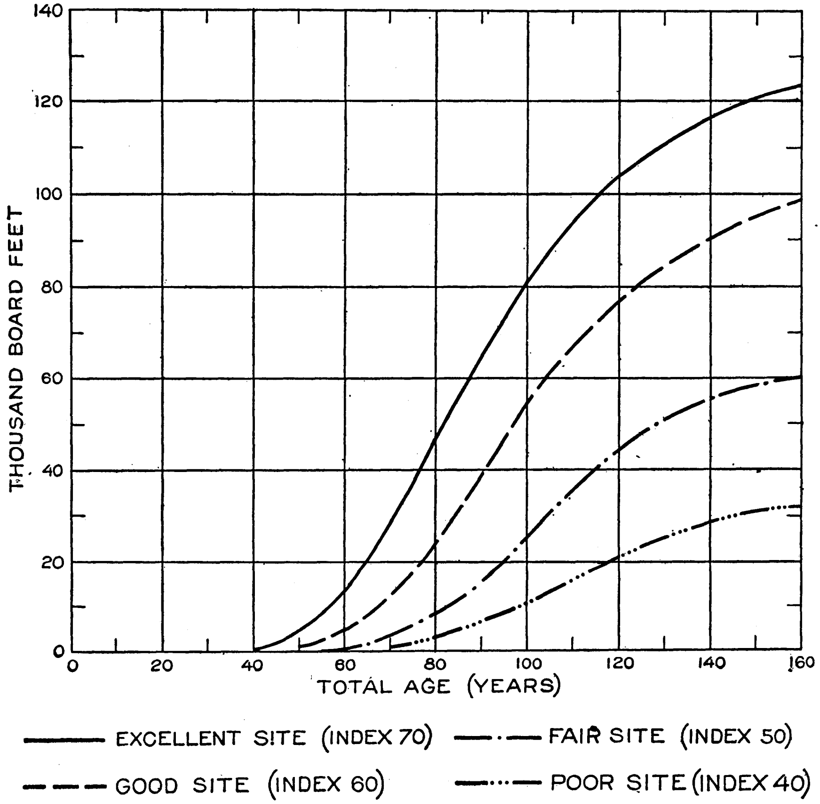

FIGURE 7.—Curves for board-foot volume per acre, international rule (⅛-inch saw kerf), trees 12.6 inches d. b. h. and larger

are principally due to the log rule. If computations for overrun are omitted, the international rule shows much more accurately than the Scribner rule the actual board-foot contents that can be cut out under efficient sawmill practice (*5*). The international rule used here assumes the use of saws cutting a ⅛-inch kerf. If a ¼-inch kerf is cut, the yields should be reduced 9.5 per cent.

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[3] For example, Scott Creek on the Coeur d'Alene National Forest, averaged 39,600 board feet per acre by actual log scale, Scribner rule. This cut was in 90 to 100 year old timber from a drainage area of 790 acres. The stand, therefore, actually cut about 74 per cent of normal 100-year volume for good site (site index 60). (Table 13.) If unmerchantable and uncut material left in the woods is included, this stand ran 75 to 85 per cent of normal over more than a section.

INCREMENT AND ROTATION AGE

Figures 8, 9, and 10 show the rate of growth in western white pine stands in terms of periodic and mean annual increment. Figure 8 portrays growth in cubic feet and Figures 9 and 10 growth in board feet in trees 6.6 inches and 12.6 inches in diameter or more, respectively. The periodic increment curves show the average rate of growth by 10-year periods, the peak of the curve in each instance indicating the decade of most rapid growth. This peak occurs between the ages of 50 and 120 years, varying with the kind of product and the site conditions. The peak or culmination of mean annual growth does not come until considerably later. This peak also is influenced by site and kind of product, and occurs on good sites (index 60) at 105 years for total wood production in cubic feet, at

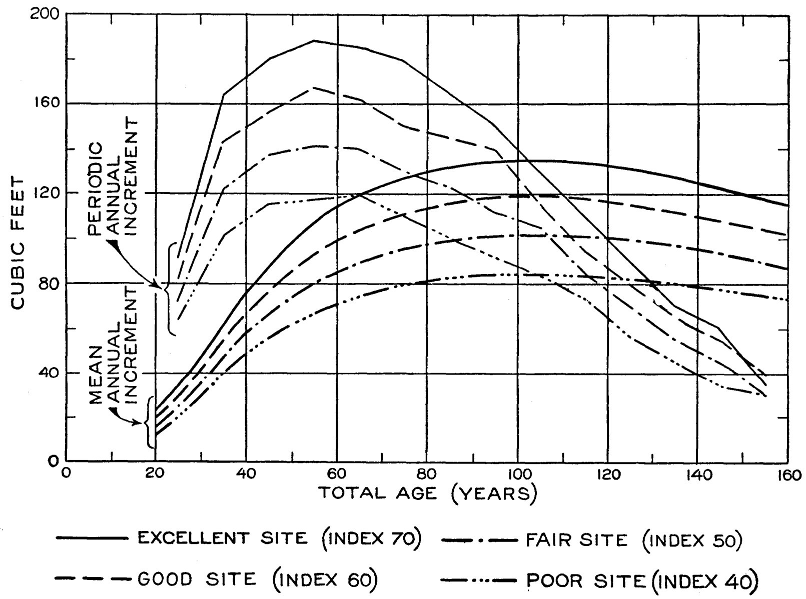

FIGURE 8.—Curves for periodic and mean annual increment in cubic feet, trees 0.6 inch d. h. b. and larger

115 years for total wood production in board feet (international rule) for trees 6.6 inches d. b. h. and larger, and at 135 years for board-foot volumes (international rule) for trees 12.6 inches and up. Growth in total board-foot volumes culminates at 110 years on excellent soils and at 130 years on poor soils. This point of culmination, or period at which maximum mean annual growth occurs, is usually spoken of as the rotation age. A stand cut at this time will yield the maximum volume return per year of growth.

Rate of growth, of course, is only one of a number of factors to be considered in fixing the proper age at which to cut a given stand. The type of product desired, the run of lumber grades, the financial aspects of prolonged holding, and the silvicultural features of the forest must all be considered in deciding upon the age at which to cut. Nevertheless, volume production alone is an important item to consider in western white pine stands, in which on most sites the board-foot contents are nearly doubled or more than doubled between 80 and 120 years.

PREDICTING THE YIELDS OF SECOND-GROWTH STANDS

To use the normal tables in predicting future yields of natural second-growth western white pine stands, it is first necessary to determine the age, site quality, and degree of stocking of the stands

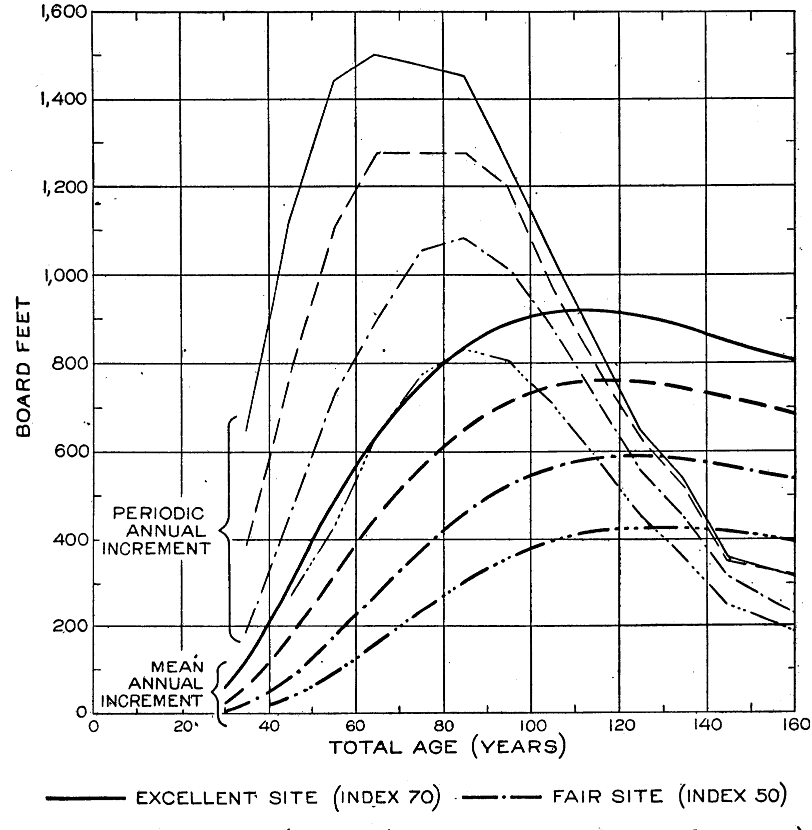

FIGURE 9.—Curves for periodic and mean annual increment in board feet, international rule, trees 6.6 inches d. h. b. and larger

for which such forecasts are to be made. These factors can be determined with relative ease on small tracts by measuring one or more selected sample areas. But for good-sized tracts this task will usually require a strip or line plot survey to locate and map age-class divisions, nontimbered areas, and distinct differences in stand density and site conditions. The general procedure in this work is practically the same as in a timber cruise, and the same factors determine the degree of intensity with which the survey is conducted. Site mapping introduces a new element, but as the range of sites in the western white pine type is relatively small, the division of a tract into two or at most three site classes should be sufficient for all practical purposes.

AGE DETERMINATION

The first step in the application of yield tables is to tally on each sample strip or plot the total number of trees in each diameter class

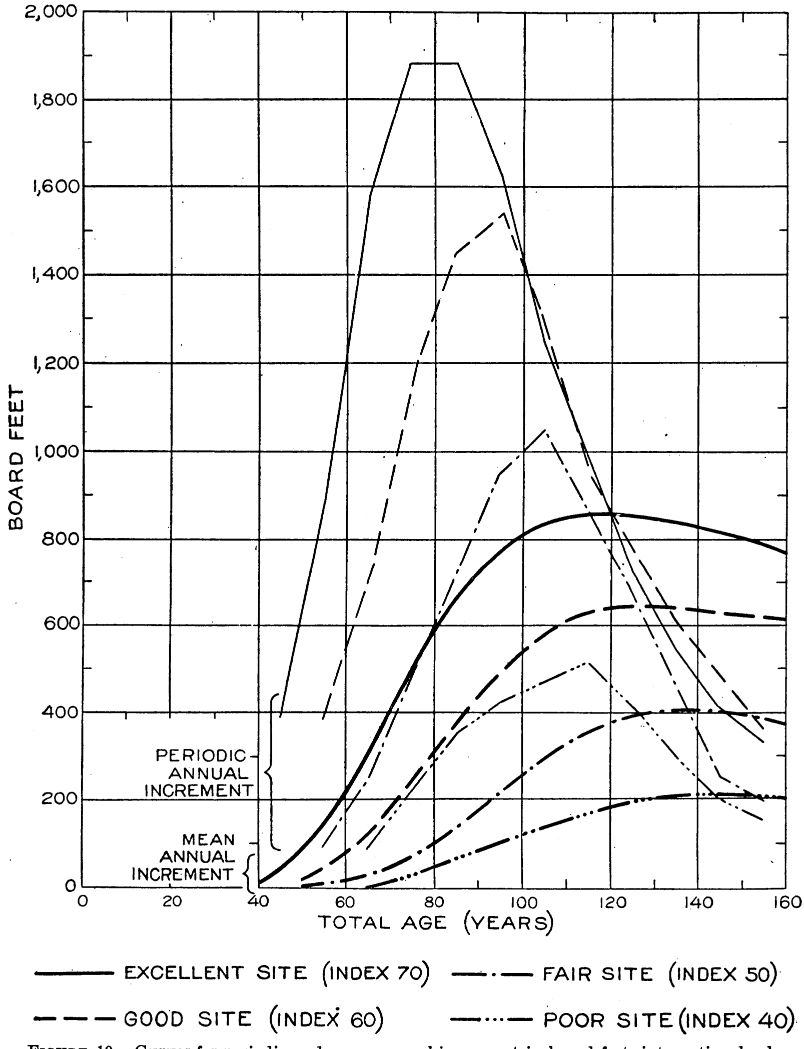

FIGURE 10.—Curves for periodic and mean annual increment in board feet, international rule. trees 12.6 inches d. b. h. and larger

1 inch and up for later use in computing stand density. In conjunction with this work, age determinations should be made on each sample plot or at frequent intervals along the strip line by counting the growth rings of several dominant white pines, either on the stump or on a core to the pith extracted with an increment borer. These

ring counts should be taken 1 foot above the average ground level or the count adjusted by adding in the number of whorls between the point of count and the 1-foot level. (The whorls or successive points along the trunk at which branches have originated are usually distinguishable on white pine trees by the knots even when the branches are entirely gone.) Add 5 years to this count on average soils, 4 years on better-than-average soils, and 6 years on poorer-than-average soils. This is the period required by dominant seedlings to grow 1 foot in height. The age of the oldest tree determined in this manner is taken as the age of the stand, provided the age of this tree does not differ by more than three years from that of the next oldest tree. This latter precaution is to avoid taking the age of veterans or relics of a former, older stand, individuals of which may have escaped the fire or other cause by which the present stand was established. Check the age by additional borings at any point where a change in age class appears to have taken place. Occasionally an intermediate or suppressed tree should be bored to see if the stand is essentially even-aged; i. e., all trees within about a 20-year range.

SITE DETERMINATION

Site determinations should also be made in conjunction with the strip or line-plot survey. This is done by measuring at fairly frequent intervals the heights of 15 to 20 dominant (dominant and codominant) white pines growing in a fairly dense portion of the stand. These heights should be measured with a Forest Service Abney level or some instrument of equal accuracy, and the distance should be taped, not paced. Extreme care must be taken to measure dominant trees of all sizes from those barely codominant up to and including the tallest trees in the stand and to distribute the measurements well over the range between these limits. Care should be taken also to exclude any surviving veterans of an older-age class. Then, for each group of trees measured, average the heights taken, refer either to Figure 2 or to the site-classification chart, Figure 11, and convert average dominant height to site index. This is done with Figure 11 by passing a straight line through the age of the stand on scale A and the average height just computed (the average height of the dominant and codominant trees) on scale B. Read the site index where this line crosses scale C. In the example illustrated, a 30-year-old stand in which the dominants averaged 20 feet in height, the site quality is classified as poor (site index 40).

DETERMINATION OF STOCKING

From the cruise data in hand, map out the major age-site divisions and compute for each the average age, site, and basal area, the latter being readily calculated from the stand tally of trees by diameter class. Then for each major area divide the computed average basal area by the yield-table basal area for the same age and site index, expressing the result as a percentage. The tabular yields at any future age for the same site index multiplied by this percentage will give the yields to be expected at that age.

For example: Given a stand 80 years of age with an average basal area per acre of 184 square feet and a site index of 60 feet; to predict the yields in basal area, cubic volume, and board-foot volume when this stand reaches 120 years, or rotation age:

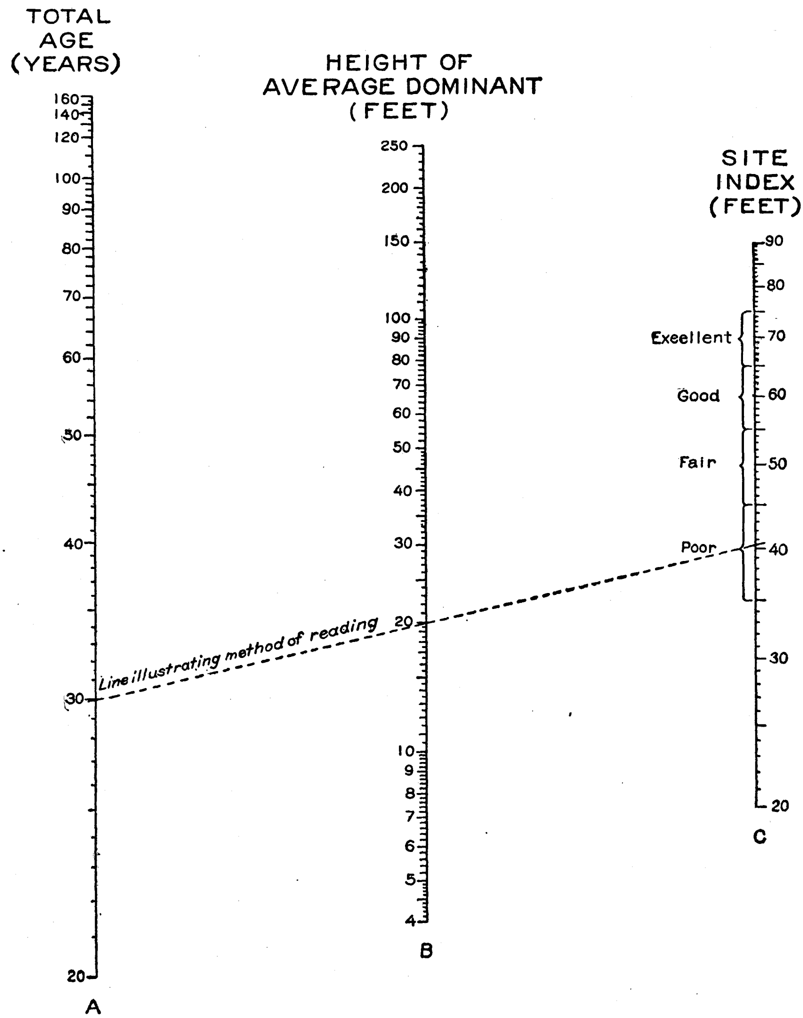

FIGURE 11.—Alinement chart for determining site index from age of stand and height of average dominant white pine

At 80 years, site index 60:

Actual basal area	=184 square feet.
Yield-table basal area	=263 square feet.
Percentage of stocking	= 70 per cent.

Yield-table values at 120 years (international rule—6.6 inches d. b. h. and larger):

Basal area	= 314 square feet.
Cubic volume	=13,950 cubic feet.
Total board-foot volume	=91,200 board feet.

These values reduced for 70 per cent stocking are:

Basal area	= 220 square feet.
Cubic volume	= 9,657 cubic feet.
Total board-foot volume	=63,840 board feet.

A conservative operator would reduce these predicted yields by at least 10 per cent more to allow for breakage in logging and defect.

OTHER FEATURES OF APPLICATION

The method of application here suggested is the conventional one of applying normal-yield tables. It has been tried on a fairly large scale in the Douglas fir region and found workable and satisfactory as far as the field work is concerned. It is based on the assumption that the present relationship between actual and tabular yields will be the same at any period in the future within the tabular limits. This assumption is, of course, subject to some error. For example, there is considerable evidence that understocked stands tend to approach or equal tabular yields with increase in age. Changes in this relationship might also be brought about through the influence of stand composition, through a material increase in the amount of defect, through the influence of climate, particularly of wet and dry cycles, or through further losses caused by snow breakage, insects, or disease. Nevertheless, the method suggested is the best now available and should prove entirely satisfactory under our present economic conditions and rough methods of management.

When board-foot-volume predictions only are desired and the stand is sufficiently advanced in years to contain a reasonable number of trees of merchantable size, a somewhat simplified procedure may be adopted. Age and site class must be determined as before. But degree of stocking can be computed by simply counting on representative areas the total number of trees above the chosen diameter limit; for example, the number of trees in and above the 7 inch or 13 inch diameter class. This number should be expressed as a percentage of the tabular number above such limits for the same age-site condition. Then the tabular figures for board-foot yields above similar diameter limits multiplied by this percentage figure will give the predicted board-foot yields. This method is recommended for short-time predictions only. Where applicable, it is probably more accurate than the conventional method.

The Forest Service is now conducting several studies in an attempt to check and improve the application of normal-yield tables (*11*). If, as is expected, one of these studies should be undertaken in the western white pine type, it may make possible a better definition of the board foot-basal area relationship and of other improvements in application technic.

DISCUSSION OF STAND TABLES

Stand tables ordinarily show numbers of trees per acre arranged by diameter classes. They may also be made to show the percentage of total number of trees per acre, or the percentage of the total volume per acre found in each diameter class or above any diameter limit. Tables 25 to 34 give the proportion of number of trees, basal area, cubic and board foot volume occurring above various diameter limits in fully stocked western white pine stands.

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APPLICATION OF STAND TABLES

To apply these tables it is necessary to know only the average diameter of the stand and the total number of trees, basal area, or volume per stand or unit of area. For example, the yield tables show that 120-year-old fully stocked stands on good sites contain on an average 390 trees, with an average diameter of 12.2 inches breast high. The stand tables, properly interpolated for an average diameter of 12.2 inches, furnish the percentage of total number of trees above various diameter limits. Then a series of readings at successive diameter limits, each reading subtracted in turn from the preceding tabular value, give the percentage of trees in each individual diameter class. These percentage values are easily converted into actual number of trees by multiplying by the total number of trees in the stand, in this case 390. Table 2 was derived in this way. The number of trees in any single diameter class or above any given diameter limit can be computed in this manner for any stand for which the average diameter and total number of trees are known. Basal area and cubic and board foot values can be obtained in similar fashion.

TABLE 2.—*Sample computation of stand table, showing the distribution of trees in a fully stocked 120-year-old stand on good site (site index 60)*

Diameter breast high (inches)	Distribution of trees by diameter class		Diameter breast high (inches)	Distribution of trees by diameter class	
	Per cent	*Number*		*Per cent*	*Number*
1–4	18	70	17–20	13	51
5–8	21	82	21–24+	5	19
9–12	21	82			
13–16	22	86	Total	100	390

The stand tables, therefore, make an excellent supplement to the yield tables proper, for they add to the yield-table figures on total number of trees or volumes per acre, additional information on the number of trees of different sizes, and the volume above various diameter limits. These figures are obviously of considerable interest and value to any operator or forest manager who is contemplating diameter-limit cuttings, or who wishes to know about how many trees or what percentage of the total volume will be available for various products, depending somewhat on size; for example, ties, pulpwood, or saw timber.

EFFECT OF STOCKING AND COMPOSITION

The stand tables are directly applicable only to fully stocked stands of average composition. They should, however, furnish satisfactory approximations of the distribution of trees and volumes in stands approaching full stocking, a condition fairly common in the western white pine type, in which well-stocked stands exclusive of large openings average, as has been said, about 70 per cent of normal.

Composition, of course, also affects tree distribution, tolerant species tending to concentrate in the smaller diameter classes and intolerant ones in the larger. The general tendency, therefore, is to underestimate the number of small trees and overestimate the number of large trees in stands running heavily to cedar and hemlock. These errors due to composition are not very serious, and may be eliminated entirely for number of tree values by the use of tables showing the distribution by diameter of trees of individual species. Tables 26 to 31, inclusive, show the distribution of the number of trees for the six most common species in the western white pine type. To use these tables it is necessary to know only the average diameter of the stand, all species included, and the number of trees of each species per unit of area. Then, dealing with each species separately, the percentage of trees in each diameter class is computed as before. The percentages for each species are then multiplied by the total number of trees of that particular species per unit of area, and the number of trees of each species in the various diameter classes derived in this way. The values for each diameter class are then added to obtain the total number of trees in each class for this particular stand composition.

DISCUSSION OF VOLUME TABLES

Volume tables show the contents of trees of various sizes in terms of some standard unit, such as cubic or board feet. Tables 35 to 64 give the volumes of the six most important species occurring in the western white pine type, namely, western white pine, western larch, western red cedar, Douglas fir, lowland white fir, and western hemlock. Tables are given in both cubic and board feet, the latter in both the international (⅛-inch) and Scribner rules to both total and merchantable height.

These volume tables list correct values only for trees of the species named occurring in western white pine stands under 160 years of age. Within these limits, however, they are usable throughout the entire western white pine region, regardless of general locality or site conditions, for a careful mathematical analysis indicates that these factors have little effect on tree form in second-growth stands and hence on tree volume when the variables of diameter and height are eliminated. Some adjustment may be necessary in local use, however, and the procedure to be followed in checking and adjusting the tables is explained in detail in the volume-table section of the appendix.

YIELD TABLES

TOTAL STAND

TABLE 3.—*Number of trees per acre 0.6 inch d. b. h. and larger*

Total age (years)	Number of trees, by site index—						Total age (years)	Number of trees, by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	15,800	11,500	7,800	4,700	2,800	2,050	100	1,700	1,220	820	480	300	215
30	10,950	8,050	5,220	3,180	1,940	1,420	110	1,480	1,060	720	420	260	185
40	7,750	5,600	3,650	2,210	1,370	1,000	120	1,350	980	660	390	235	170
50	5,600	4,070	2,680	1,590	1,000	710	130	1,290	930	630	370	225	165
60	4,150	3,020	2,000	1,190	760	540	140	1,250	910	610	355	220	160
70	3,180	2,300	1,550	930	580	410	150	1,220	900	600	350	215	155
80	2,500	1,830	1,230	720	450	320	160	1,210	890	590	345	215	155
90	2,030	1,460	990	580	360	260							

TABLE 4.—*Size of average tree, based on diameter breast high of tree of average basal area*

Total age (years)	Average diameter breast high (inches), by site index—						Total age (years)	Average diameter breast high (inches), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	0.7	0.8	1.0	1.3	1.7	2.0	100	5.5	6.5	8.0	10.5	13.5	16.0
30	1.3	1.5	1.9	2.4	3.1	3.7	110	6.0	7.1	8.8	11.5	14.7	17.5
40	1.8	2.2	2.7	3.5	4.5	5.3	120	6.4	7.6	9.3	12.2	15.7	18.6
50	2.4	2.9	3.6	4.7	5.9	7.1	130	6.7	7.9	9.7	12.7	16.3	19.3
60	3.1	3.6	4.5	5.8	7.4	8.8	140	6.8	8.1	10.0	13.1	16.7	19.9
70	3.7	4.3	5.3	7.0	8.9	10.6	150	7.0	8.2	10.2	13.4	17.0	20.3
80	4.3	5.1	6.2	8.2	10.4	12.4	160	7.1	8.3	10.3	13.6	17.2	20.5
90	4.9	5.8	7.1	9.4	12.0	14.2							

TABLE 5.—*Basal area per acre in trees 0.6 inch d. b. h. and larger*

Total age (years)	Basal area (square feet), by site index—						Total age (years)	Basal area (square feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	44	45	46	46	47	47	100	282	286	289	292	296	300
30	99	100	101	102	104	105	110	293	296	300	304	308	311
40	144	146	148	149	151	153	120	302	306	310	314	318	322
50	182	184	186	189	191	194	130	311	315	319	323	327	331
60	212	215	218	221	223	226	140	319	323	327	331	335	340
70	235	238	241	244	247	250	150	326	331	335	339	343	348
80	253	257	260	263	266	270	160	333	338	342	346	350	354
90	269	272	275	279	282	286							

TABLE 6.—*Total cubic-foot volume per acre, including stump and tip but not bark for all trees 0.6 inch d. b. h. and larger*

Total age (years)	Volume (cubic feet), by site index—						Total age (years)	Volume (cubic feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	170	240	320	400	470	540	100	6,720	8,420	10,100	11,850	13,500	15,400
30	700	880	1,050	1,220	1,390	1,570	110	7,350	9,250	11,150	13,000	14,800	16,850
40	1,500	1,890	2,270	2,650	3,030	3,400	120	7,890	9,980	12,000	13,950	15,900	18,100
50	2,400	3,040	3,640	4,210	4,830	5,470	130	8,360	10,550	12,700	14,750	16,800	19,100
60	3,370	4,210	5,050	5,880	6,710	7,600	140	8,740	11,000	13,250	15,400	17,500	19,900
70	4,280	5,400	6,450	7,500	8,560	9,730	150	9,010	11,350	13,700	15,950	18,100	20,550
80	5,160	6,500	7,750	9,000	10,350	11,750	160	9,200	11,650	14,000	16,350	18,450	21,000
90	5,980	7,500	8,980	10,450	12,000	13,650							

TABLE 7.—*Mean annual cubic-foot increment per acre in trees 0.6 inch d. b. h. and larger*

Total age (years)	Increment (cubic feet), by site index—						Total age (years)	Increment (cubic feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	8	12	16	20	24	27	100	67	84	101	118	135	154
30	23	29	35	41	46	52	110	67	84	101	118	135	153
40	38	47	57	66	76	85	120	66	83	100	116	132	151
50	48	61	73	84	97	109	130	64	81	98	113	129	147
60	56	70	84	98	112	127	140	62	79	95	110	125	142
70	61	77	92	107	122	139	150	60	76	91	106	121	137
80	64	81	97	112	129	147	160	58	73	88	102	115	131
90	66	83	100	116	133	152							

TREES 6.6 INCHES D. B. H. AND LARGER

TABLE 8.—*Number of trees per acre 6.6 inches d. b. h. and larger*

Total age (years)	Number of trees, by site index—						Total age (years)	Number of trees, by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	-	-	-	-	-	5	100	425	440	420	330	240	185
30	-	-	-	30	70	100	110	455	450	405	310	220	170
40	-	25	65	130	200	220	120	470	455	400	295	205	160
50	50	105	170	255	295	295	130	480	460	395	285	200	155
60	140	200	275	340	335	305	140	490	465	390	280	195	[1]
70	230	295	355	370	330	280	150	495	470	390	280	195	[1]
80	310	370	405	370	305	245	160	500	475	390	275	195	[1]
90	380	420	420	360	270	215							

[1] No data.

TABLE 9.—*Average diameter of trees per acre, 6.6 inches d. b. h. and larger*

Total age (years)	Average diameter breast high (inches), by site index—						Total age (years)	Average diameter breast high (inches), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	-	-	-	-	-	7.4	100	9.0	9.6	10.5	12.4	14.9	17.1
30	-	-	-	7.5	7.8	8.1	110	9.3	9.9	11.1	13.2	16.0	18.4
40	-	7.5	7.7	8.0	8.5	8.9	120	9.5	10.2	11.5	13.8	16.8	19.3
50	7.5	7.7	8.0	8.6	9.2	9.9	130	9.7	10.4	11.8	14.2	17.3	19.8
60	7.8	8.0	8.5	9.2	10.1	11.1	140	9.8	10.6	12.0	14.5	17.7	[1]
70	8.1	8.4	8.9	9.9	11.1	12.5	150	9.9	10.7	12.2	14.8	18.0	[1]
80	8.4	8.8	9.4	10.7	12.3	14.0	160	9.9	10.8	12.3	15.0	18.1	[1]
90	8.7	9.2	9.9	11.5	13.6	15.5							

[1] No data.

TABLE 10.—*Basal area per acre in trees 6.6 inches d. b. h. and larger*

Total age (years)	Basal area (square feet), by site index—						Total age (years)	Basal area (square feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	-	-	-	-	-	1	100	189	221	251	277	290	298
30	-	-	-	9	23	35	110	214	241	271	293	304	312
40	-	8	21	45	79	94	120	231	258	286	305	315	323
50	15	33	60	103	137	157	130	245	271	298	315	326	333
60	47	69	108	157	187	205	140	255	283	307	324	335	[1]
70	83	113	154	199	223	238	150	264	293	316	332	343	[1]
80	120	157	194	232	252	261	160	271	302	323	339	349	[1]
90	158	194	225	258	273	281							

[1] No data.

TABLE 11.—*Total board-foot volume per acre in trees 6.6 inches d. b. h. and larger, international rule, 1/8-inch saw kerf*

Total age (years)	Volume (board feet), by site index—						Total age (years)	Volume (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	-	-	-	-	-	100	100	24,700	38,000	54,300	73,500	90,500	106,100
30	-	-	-	600	1,700	2,900	110	30,200	45,100	63,100	83,200	100,900	117,300
40	-	500	1,900	4,400	8,300	12,000	120	34,800	51,000	70,300	91,200	109,400	126,500
50	1,300	3,200	6,500	12,300	19,500	26,200	130	38,400	55,600	75,900	97,500	115,900	133,700
60	3,900	7,500	13,700	23,300	33,800	43,000	140	41,000	59,200	80,400	102,700	121,300	[1]
70	8,000	13,900	22,800	36,000	48,800	60,700	150	43,100	61,700	83,600	106,700	125,400	[1]
80	13,100	21,600	33,300	48,700	63,500	77,200	160	44,700	63,600	85,900	109,900	128,600	[1]
90	18,800	29,900	44,100	61,500	78,000	92,800							

[1] No data.

TABLE 12.—*Mean annual board-foot increment per acre in trees 6.6 inches d. b. h. and larger, international rule, ⅛-inch saw kerf*

Total age (years)	Increment (board feet), by site index—						Total age (years)	Increment (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20						5	100	247	380	543	735	905	1,061
30				20	57	97	110	275	410	574	756	917	1,066
40		12	48	110	208	300	120	290	425	586	760	912	1,054
50	26	64	130	246	390	524	130	295	428	584	750	892	1,028
60	65	125	228	388	563	717	140	293	423	574	734	866	[1]
70	114	199	326	514	697	867	150	287	411	557	711	836	[1]
80	164	270	416	609	794	965	160	279	398	537	687	804	[1]
90	209	332	490	683	867	1,031							

[1] No data.

TREES 7.6 INCHES D. B. H. AND LARGER

TABLE 13.—*Board-foot volume per acre in trees 7.6 inches d. b. h. and larger, Scribner rule*

Total age (years)	Volume (board feet), by site index—						Total age (years)	Volume (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20							100	13,600	22,600	36,300	53,500	68,500	82,500
30				150	450	1,200	110	17,500	28,300	43,600	62,100	77,500	92,000
40		50	400	1,700	3,900	6,200	120	20,800	33,100	49,500	68,700	84,700	99,400
50	250	900	2,500	6,000	11,100	16,400	130	23,300	36,700	54,100	73,700	90,500	105,800
60	1,100	2,900	6,600	13,100	21,700	29,700	140	25,400	39,400	57,900	77,600	95,100	[1]
70	3,200	6,500	12,300	22,500	33,800	44,300	150	27,000	41,500	60,600	80,900	98,500	[1]
80	6,000	11,300	19,500	32,800	46,500	58,200	160	28,200	43,200	62,300	83,700	100,500	[1]
90	9,600	16,800	27,900	43,300	58,300	71,300							

[1] No data.

TABLE 14.—*Mean annual increment in trees 7.6 inches d. b. h. and larger, Scribner rule*

Total age (years)	Increment (board feet), by site index—						Total age (years)	Increment (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20							100	136	226	363	535	685	825
30				5	15	40	110	159	257	396	565	705	836
40		1	10	42	98	155	120	173	276	412	572	706	828
50	5	18	50	120	222	328	130	179	282	416	567	696	814
60	18	48	110	218	362	495	140	181	281	414	554	679	[1]
70	46	93	176	321	483	633	150	180	277	404	539	657	[1]
80	75	141	244	410	581	728	160	176	270	389	523	628	[1]
90	107	187	310	481	648	792							

[1] No data.

TREES 12.6 INCHES D. B. H. AND LARGER

TABLE 15.—*Number of trees per acre 12.6 inches d. b. h. and larger*

Total age (years)	Number of trees, by site index—						Total age (years)	Number of trees, by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
40[1]					4	8	110	31	57	101	143	147	131
50			1	4	17	38	120	40	71	116	153	147	126
60		1	5	19	49	78	130	48	82	128	159	147	[2]
70	1	5	14	44	86	110	140	56	90	138	164	148	[2]
80	5	13	31	76	115	132	150	60	97	144	167	148	[2]
90	12	24	54	106	134	139	160	64	102	147	171	149	[2]
100	22	41	80	128	145	137							

[1] No 12.6-inch trees below 40-year class. [2] No data.

TABLE 16.—*Average diameter of trees 12.6 inches d. b. h. and larger*

Total age (years)	Average diameter breast high (inches), by site index—						Total age (years)	Average diameter breast high (inches), by site index					
	30	40	50	60	70	80		30	40	50	60	70	80
40[1]	------	------	------	------	13.8	14.0	110	14.1	14.4	15.0	16.3	18.2	19.9
50	------	------	13.8	13.8	14.1	14.4	120	14.2	14.6	15.2	16.7	18.8	20.6
60	------	13.8	13.8	14.0	14.5	15.0	130	14.3	14.7	15.4	17.0	19.2	([2])
70	13.8	13.8	14.0	14.4	15.0	15.8	140	14.3	14.8	15.5	17.2	19.4	([2])
80	13.8	13.9	14.1	14.8	15.7	16.8	150	14.4	14.8	15.6	17.4	19.6	([2])
90	13.9	14.0	14.4	15.3	16.6	17.9	160	14.4	14.8	15.7	17.5	19.7	([2])
100	14.0	14.2	14.7	15.8	17.5	19.0							

[1] No 12.6-inch trees below 40-year class. [2] No data.

TABLE 17.—*Basal area per acre in trees 12.6 inches d. b. h. and larger*

Total age (years)	Basal area (square feet), by site index—						Total age (years)	Basal area (square feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
40[1]	------	------	------	------	4	9	110	34	65	124	207	266	283
50	------	------	1	4	19	43	120	44	83	146	232	283	292
60	------	1	5	20	56	96	130	54	97	166	251	296	([2])
70	1	5	15	50	105	150	140	62	108	181	265	304	([2])
80	5	14	34	91	154	203	150	68	116	191	276	310	([2])
90	13	26	61	135	202	243	160	72	122	198	286	315	([2])
100	24	45	94	175	242	270							

[1] No 12.6-inch trees below 40-year class. [2] No data.

TABLE 18.—*Board-foot volume per acre in trees 12.6 inches d. b. h. and larger, international rule (⅛-inch saw kerf)*

Total age (years)	Volume (board feet), by site index—						Total age (years)	Volume (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
40[1]	------	------	------	------	600	2,000	110	7,100	15,700	35,500	66,800	93,500	113,500
50	------	------	50	1,300	4,500	9,000	120	9,700	21,000	44,100	76,300	103,300	122,400
60	------	50	1,000	5,000	13,400	24,300	130	11,900	25,200	50,900	84,100	110,600	([2])
70	100	1,000	3,600	12,300	28,200	45,000	140	13,600	28,100	55,600	90,300	116,100	([2])
80	700	3,200	8,400	24,100	46,000	65,600	150	14,800	30,200	58,200	95,200	120,300	([2])
90	2,400	6,600	15,500	38,600	64,800	84,500	160	15,700	31,700	60,200	98,900	123,600	([2])
100	4,600	11,000	25,000	54,000	81,000	100,700							

[1] No 12.6-inch trees below 40-year class. [2] No data.

TABLE 19.—*Board-foot volume per acre in trees 12.6 inches d. b. h. and larger, Scribner rule*

Total age (years)	Volume (board feet), by site index—						Total age (years)	Volume (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
40[1]	------	------	------	------	400	1,400	110	5,400	12,400	26,100	50,800	73,400	88,600
50	------	------	50	800	3,300	7,000	120	7,600	16,000	32,200	59,000	81,000	96,000
60	------	50	700	3,700	10,300	17,800	130	9,500	18,800	37,000	65,200	87,000	([2])
70	100	600	2,800	9,700	21,200	34,000	140	10,900	21,000	41,000	70,500	91,600	([2])
80	500	2,300	6,500	17,900	34,600	50,500	150	11,700	22,700	43,800	74,400	94,800	([2])
90	1,600	4,800	12,100	28,700	50,300	65,500	160	12,500	24,300	45,500	76,900	96,800	([2])
100	3,300	8,300	19,200	40,300	63,200	79,100							

[1] No 12.6-inch trees below 40-year class. [2] No data.

TABLE 20.—*Mean annual board-foot increment per acre in trees 12.6 inches d. b. h. and larger, international rule (⅛-inch saw kerf)*

Total age (years)	Increment (board feet), by site index—						Total age (years)	Increment (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
30[1]						2	100	46	110	250	540	810	1,007
40					15	50	110	65	143	323	607	850	1,032
50			1	26	90	180	120	81	175	368	636	861	1,020
60		1	17	83	223	405	130	92	194	392	647	851	(2)
70	1	14	51	176	403	643	140	97	201	397	645	829	(2)
80	9	40	105	301	575	820	150	99	201	388	635	802	(2)
90	27	73	172	429	720	939	160	98	198	376	618	772	(2)

[1] No 12.6-inch trees below 30-year class. [2] No data.

TABLE 21.—*Mean annual board-foot increment per acre in trees 12.6 inches d. b. h. and larger, Scribner rule*

Total age (years)	Increment (board feet), by site index—						Total age (years)	Increment (board feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
40[1]					10	35	110	49	113	237	462	667	805
50			1	16	66	140	120	63	133	268	492	675	800
60		1	12	62	172	297	130	73	145	285	502	669	(2)
70	1	9	40	139	303	486	140	78	150	293	504	654	(2)
80	6	29	81	224	433	631	150	78	151	292	496	632	(2)
90	18	53	134	319	559	728	160	78	152	284	481	605	(2)
100	33	83	192	403	632	791							

[1] No 12.6-inch trees below 40-year class. [2] No data.

DOMINANT STAND

TABLE 22.—*Average diameter of dominant stand (dominant and codominant trees)*

Total age (years)	Average diameter breast high (inches), by site index—						Total age (years)	Average diameter breast high (inches), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	1.0	1.2	1.5	2.1	2.9	3.4	100	8.9	10.2	12.1	14.8	17.6	19.8
30	2.1	2.5	3.1	4.1	5.2	6.2	110	9.6	11.0	13.0	15.8	18.7	21.0
40	3.1	3.7	4.6	5.9	7.4	8.6	120	10.1	11.6	13.6	16.5	19.5	(1)
50	4.1	4.9	6.0	7.7	9.4	11.0	130	10.5	12.0	14.0	17.0	20.1	(1)
60	5.2	6.0	7.4	9.3	11.3	13.0	140	10.7	12.2	14.3	17.3	20.4	(1)
70	6.2	7.1	8.6	10.8	13.1	14.9	150	10.8	12.3	14.5	17.5	20.7	(1)
80	7.1	8.3	9.9	12.3	14.7	16.7	160	11.0	12.4	14.6	17.7	20.8	(1)
90	8.1	9.3	11.0	13.6	16.3	18.3							

[1] No data.

TABLE 23.—*Cubic-foot volume per acre in dominant stand (dominant and codominant trees)*

Total age (years)	Volume (cubic feet), by site index—						Total age (years)	Volume (cubic feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	100	150	200	250	300	350	100	4,850	6,200	7,700	9,400	11,400	13,650
30	450	550	700	850	950	1,100	110	5,350	6,900	8,600	10,550	12,800	15,350
40	1,000	1,250	1,500	1,800	2,100	2,450	120	5,800	7,500	9,350	11,500	14,000	16,750
50	1,600	2,050	2,500	3,000	3,500	4,050	130	6,150	8,000	9,950	12,300	14,950	(1)
60	2,300	2,900	3,550	4,250	5,050	5,850	140	6,450	8,350	10,450	12,950	15,700	(1)
70	2,950	3,800	4,650	5,550	6,600	7,750	150	6,700	8,650	10,850	13,450	16,300	(1)
80	3,600	4,650	5,650	6,850	8,250	9,700	160	6,850	8,900	11,150	13,850	16,700	(1)
90	4,250	5,450	6,700	8,150	9,850	11,650							

[1] No data.

TABLE 24.—*Height of average dominant (dominant and codominant) western white pine*

Total age (years)	Height (feet), by site index—						Total age (years)	Height (feet), by site index—					
	30	40	50	60	70	80		30	40	50	60	70	80
20	7	10	12	14	16	19	100	59	79	99	118	138	158
30	15	20	25	30	35	40	110	63	84	105	126	147	167
40	23	30	38	45	53	60	120	66	88	110	132	154	175
50	30	40	50	60	70	80	130	68	91	114	137	160	182
60	37	49	61	73	86	98	140	70	94	117	141	164	188
70	43	58	72	86	101	116	150	72	96	120	144	168	192
80	49	66	82	98	115	132	160	73	98	122	146	171	195
90	54	73	91	109	128	145							

STAND TABLES

TABLE 25.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; all species combined*

Diameter class (inches)	Distribution (per cent) by average stand diameter																
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches
1	100	100	100	100	100	100	100	100	100	100	100	100	100	----	----	----	----
2	56	75	84	87	89	90	92	92	93	94	96	98	99	----	----	----	----
3	8	42	62	72	77	81	83	85	87	89	92	95	98	99	----	----	----
4	----	16	42	56	65	71	75	78	81	83	86	91	95	98	----	----	----
5	----	4	24	42	53	61	67	71	75	78	81	86	91	96	99	----	----
6	----	----	12	28	43	53	59	65	69	73	76	81	86	92	96	99	----
7	----	----	5	18	33	44	52	58	63	67	71	76	82	87	93	96	99
8	----	----	2	10	23	35	44	51	57	62	66	71	77	82	88	93	96
9	----	----	----	5	15	26	36	44	50	56	60	66	71	77	83	87	92
10	----	----	----	2	9	19	28	37	44	50	55	61	66	72	77	82	87
11	----	----	----	----	5	13	22	31	38	44	50	55	61	66	72	77	82
12	----	----	----	----	3	9	16	24	32	39	44	50	56	61	67	72	76
13	----	----	----	----	2	5	11	19	26	33	38	44	50	55	61	66	70
14	----	----	----	----	----	3	8	14	20	27	33	39	44	49	55	60	64
15	----	----	----	----	----	2	5	10	16	22	27	33	38	44	49	54	58
16	----	----	----	----	----	----	2	6	12	17	22	27	33	37	43	47	51
17	----	----	----	----	----	----	----	4	8	13	17	22	26	31	36	41	45
18	----	----	----	----	----	----	----	2	5	9	13	17	21	25	30	34	38
19	----	----	----	----	----	----	----	----	4	6	10	13	16	20	24	28	31
20	----	----	----	----	----	----	----	----	2	5	7	10	12	15	19	22	25
21	----	----	----	----	----	----	----	----	----	3	5	7	9	11	14	17	19
22	----	----	----	----	----	----	----	----	----	2	3	5	6	8	10	13	15
23	----	----	----	----	----	----	----	----	----	----	2	3	4	6	7	9	11
24	----	----	----	----	----	----	----	----	----	----	----	2	3	4	5	6	8
25	----	----	----	----	----	----	----	----	----	----	----	----	2	2	3	4	5

TABLE 26.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; western white pine only*

Diameter class (inches)	Distribution (per cent) by average stand diameter															
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches
1	100	100	100	100	100	100	100	100								
2	62	84	89	91	94	97	98	99								
3		51	72	81	86	90	94	96	98	99						
4		19	50	67	76	83	88	92	95	97	99					
5		4	29	50	65	74	80	86	90	93	96	98				
6			14	34	52	64	73	79	85	89	93	95	98	99		
7			6	22	39	52	64	72	78	83	88	92	94	96	99	
8			2	12	29	42	54	64	71	77	83	87	90	93	96	98
9				6	19	32	44	55	64	71	77	82	86	89	93	95
10				3	12	23	34	46	54	64	71	76	81	85	89	92
11				1	7	16	26	37	46	55	64	70	75	79	84	88
12					4	11	20	29	38	47	56	64	69	74	79	83
13					2	7	14	23	31	40	49	57	63	68	74	78
14					1	4	10	17	24	33	41	49	56	62	68	73
15						3	6	12	19	26	34	42	48	54	62	67
16						1	4	9	14	21	28	35	41	47	54	60
17							3	6	10	16	22	29	34	40	47	53
18							1	4	7	11	17	23	28	33	39	46
19								2	4	8	12	18	22	27	32	38
20									3	5	9	13	17	21	26	32
21									2	3	6	9	12	16	20	25
22									1	2	4	6	8	11	14	19
23										1	2	4	5	7	10	13
24											1	2	3	5	7	9
25												1	2	3	4	6

TABLE 27.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; western larch only*

Diameter class (inches)	Distribution (per cent) by average stand diameter																
	1 inch	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches
1	100	100	100	100	100												
2	74	82	88	92	97												
3	15	49	68	79	90	99											
4	1	20	44	63	79	92	99										
5		5	25	45	65	83	93										
6		1	12	31	51	72	86	95									
7			4	19	38	59	76	87	95	99							
8			2	11	28	47	65	78	88	94	98						
9				5	18	36	52	68	79	87	93	97					
10				3	11	26	41	56	68	78	85	91	95	99			
11				1	6	18	32	45	58	68	77	83	89	93	96	98	
12					4	12	23	35	46	57	66	74	80	85	90	93	96
13					2	7	16	26	37	46	56	64	70	77	82	86	90
14					1	4	10	19	28	37	45	53	60	67	73	78	82
15						3	7	13	21	29	36	43	50	58	63	69	74
16						2	4	9	15	22	28	35	40	47	53	59	64
17						1	3	5	10	15	21	27	32	38	43	49	54
18							2	3	6	10	15	20	25	31	35	39	44
19							1	2	4	7	10	14	18	23	27	31	36
20								1	3	4	7	10	13	17	21	25	29
21									2	3	4	7	9	12	15	18	22
22									1	2	3	4	6	8	10	13	16
23										1	2	3	4	5	7	9	11
24											1	2	3	4	5	6	8
25												1	2	2	3	4	5

TABLE 28.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; western hemlock only*

Diameter class (inches)	Distribution (per cent) by average stand diameter																
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches
1	100	100	100	100	100	100	100	100	100	----	----	----	----	----	----	----	----
2	25	57	70	80	86	89	92	95	98	----	----	----	----	----	----	----	----
3	2	22	41	55	64	71	77	82	86	89	92	95	----	----	----	----	----
4	----	7	21	35	46	54	62	68	72	78	82	86	90	96	----	----	----
5	----	1	10	22	32	41	49	55	61	66	70	76	82	88	94	----	----
6	----	----	4	13	22	30	38	45	51	57	62	67	72	79	86	92	----
7	----	----	1	8	15	22	29	37	43	49	54	59	65	71	79	86	92
8	----	----	----	4	10	15	22	28	35	41	46	51	57	63	69	77	84
9	----	----	----	1	6	11	16	22	28	33	39	44	50	56	62	68	76
10	----	----	----	----	3	7	11	16	21	27	32	37	42	48	54	61	67
11	----	----	----	----	1	4	8	12	16	21	26	31	36	41	47	53	59
12	----	----	----	----	----	2	5	9	12	17	21	25	30	35	41	46	52
13	----	----	----	----	----	1	3	6	9	13	16	20	24	29	34	39	45
14	----	----	----	----	----	----	1	4	6	9	12	16	20	24	28	33	38
15	----	----	----	----	----	----	----	2	4	6	9	12	15	19	23	27	31
16	----	----	----	----	----	----	----	1	2	4	6	9	12	15	18	22	25
17	----	----	----	----	----	----	----	----	1	3	4	6	9	11	14	17	20
18	----	----	----	----	----	----	----	----	----	1	3	4	6	8	11	13	16
19	----	----	----	----	----	----	----	----	----	----	1	3	4	6	8	10	12
20	----	----	----	----	----	----	----	----	----	----	----	1	3	4	6	8	9
21	----	----	----	----	----	----	----	----	----	----	----	----	1	3	4	5	7
22	----	----	----	----	----	----	----	----	----	----	----	----	----	1	2	3	4
23	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1	2	3
24	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1	1

TABLE 29.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; lowland white fir only*

Diameter class (inches)	Distribution (per cent) by average stand diameter															
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches
1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2	40	62	73	80	85	88	90	91	91	92	92	93	93	94	94	95
3	----	24	41	52	60	67	72	75	78	79	80	80	81	82	82	83
4	----	5	23	38	47	55	60	64	67	68	70	71	71	72	73	74
5	----	----	9	25	36	44	51	55	58	59	61	62	63	64	65	65
6	----	----	3	15	27	36	44	48	51	53	55	56	57	58	59	59
7	----	----	----	7	19	29	37	42	45	47	49	50	51	52	53	54
8	----	----	----	3	12	22	31	36	40	42	44	45	46	47	48	49
9	----	----	----	1	7	16	25	31	35	37	40	41	42	43	44	45
10	----	----	----	----	4	11	21	27	30	33	35	37	38	39	40	41
11	----	----	----	----	1	7	16	22	26	29	31	33	34	35	37	38
12	----	----	----	----	----	5	12	18	22	25	28	29	31	32	33	34
13	----	----	----	----	----	3	8	14	18	21	24	26	27	28	30	31
14	----	----	----	----	----	1	6	11	15	18	21	22	24	25	27	28
15	----	----	----	----	----	----	4	8	12	15	17	19	21	22	23	25
16	----	----	----	----	----	----	3	6	9	12	14	16	18	19	21	22
17	----	----	----	----	----	----	2	4	7	9	12	14	15	17	18	19
18	----	----	----	----	----	----	1	3	5	7	9	11	13	14	15	16
19	----	----	----	----	----	----	----	2	4	5	7	9	10	12	13	14
20	----	----	----	----	----	----	----	1	3	4	6	7	8	10	11	12
21	----	----	----	----	----	----	----	----	2	3	5	6	7	8	9	10
22	----	----	----	----	----	----	----	----	1	2	3	4	5	6	7	8
23	----	----	----	----	----	----	----	----	----	1	2	3	4	5	6	7
24	----	----	----	----	----	----	----	----	----	----	1	2	3	4	5	5
25	----	----	----	----	----	----	----	----	----	----	----	1	2	3	4	4

TABLE 30.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; Douglas fir only*

Diameter class (inches)	Distribution (per cent) by average stand diameter																	
	1 inch	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches
1	100	100	100	100	100	100	100	100	----	----	----	----	----	----	----	----	----	----
2	4	50	79	89	94	97	98	99	----	----	----	----	----	----	----	----	----	----
3	----	14	48	72	84	91	95	97	99	99	----	----	----	----	----	----	----	----
4	----	2	21	46	69	82	90	94	97	98	99	----	----	----	----	----	----	----
5	----	----	7	26	49	69	82	89	94	97	98	99	99	99	----	----	----	----
6	----	----	2	13	33	53	71	83	90	94	96	97	98	98	99	99	99	----
7	----	----	----	6	20	39	59	74	84	91	94	96	97	97	98	98	98	99
8	----	----	----	2	11	27	46	63	77	86	90	93	94	96	96	97	97	98
9	----	----	----	----	6	18	34	51	66	79	85	89	91	93	94	95	95	96
10	----	----	----	----	3	11	25	41	56	72	80	84	87	90	91	92	93	94
11	----	----	----	----	1	7	18	33	46	64	73	79	82	86	87	89	90	91
12	----	----	----	----	----	4	11	24	37	54	65	71	76	80	82	84	86	88
13	----	----	----	----	----	2	7	17	29	44	56	63	69	74	76	79	81	83
14	----	----	----	----	----	----	5	12	22	36	47	54	61	67	70	73	75	78
15	----	----	----	----	----	----	3	8	16	29	38	45	52	59	62	66	68	71
16	----	----	----	----	----	----	1	5	12	22	32	38	44	51	54	58	62	65
17	----	----	----	----	----	----	----	3	8	17	25	31	37	43	46	50	53	57
18	----	----	----	----	----	----	----	2	6	13	20	25	30	36	39	43	46	50
19	----	----	----	----	----	----	----	1	4	9	15	19	24	30.	32	36	39	42
20	----	----	----	----	----	----	----	----	3	6	11	15	19	24	26	30	32	36
21	----	----	----	----	----	----	----	----	1	5	8	11	14	19	21	24	26	30
22	----	----	----	----	----	----	----	----	----	3	5	8	11	14	16	19	21	24
23	----	----	----	----	----	----	----	----	----	2	4	6	8	11	12	15	17	19
24	----	----	----	----	----	----	----	----	----	1	2	4	6	8	9	11	13	15
25	----	----	----	----	----	----	----	----	----	----	1	3	4	6	7	8	10	11
26	----	----	----	----	----	----	----	----	----	----	----	2	3	4	5	6	7	9
27	----	----	----	----	----	----	----	----	----	----	----	1	2	3	3	5	5	6
28	----	----	----	----	----	----	----	----	----	----	----	----	1	2	2	4	4	5
29	----	----	----	----	----	----	----	----	----	----	----	----	----	1	1	3	3	4
30	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	2	3	3

TABLE 31.—*Percentage distribution of trees in and above successive diameter classes in stands of different average diameter; western red cedar only*

Diameter class (inches)	Distribution (per cent) by average stand diameter																
	1 inch	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches
1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	----	----	----
2	3	21	37	53	63	70	75	79	82	84	86	90	94	98	----	----	----
3	----	1	5	11	20	29	38	45	52	58	65	71	80	91	98	----	----
4	----	----	1	4	8	13	20	27	35	42	48	56	66	79	92	98	----
5	----	----	----	1	4	7	11	17	23	31	38	46	55	68	83	95	----
6	----	----	----	----	2	5	8	11	17	22	29	37	45	58	73	89	98
7	----	----	----	----	----	3	5	8	12	16	22	29	37	48	63	80	94
8	----	----	----	----	----	2	4	6	9	12	17	24	31	41	55	70	88
9	----	----	----	----	----	1	2	4	7	9	13	18	25	34	46	61	78
10	----	----	----	----	----	----	1	3	5	7	10	15	20	28	38	51	68
11	----	----	----	----	----	----	----	2	4	6	8	12	16	23	32	43	59
12	----	----	----	----	----	----	----	1	3	4	7	9	13	18	25	36	49
13	----	----	----	----	----	----	----	----	2	3	5	7	10	14	19	28	39
14	----	----	----	----	----	----	----	----	1	2	4	6	8	10	15	21	30
15	----	----	----	----	----	----	----	----	----	1	3	4	6	8	10	15	21
16	----	----	----	----	----	----	----	----	----	----	2	3	4	6	8	10	15
17	----	----	----	----	----	----	----	----	----	----	1	2	3	4	6	8	10
18	----	----	----	----	----	----	----	----	----	----	----	1	2	3	4	5	7
19	----	----	----	----	----	----	----	----	----	----	----	----	1	2	2	3	4
20	----	----	----	----	----	----	----	----	----	----	----	----	----	1	1	2	3
21	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1	2
22	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1

TABLE 32.—*Percentage distribution of basal area in and above successive diameter classes in stands of different average diameter; all species combined*

Diameter class (inches)	Distribution (per cent) by average stand diameter																		
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches	19 inches	20 inches
1	100	100	100	100															
2	95	96	97	98															
3	78	88	93	96	97	98													
4	49	73	84	91	94	96	98												
5	20	52	72	83	89	93	95	97	98										
6	7	32	57	73	82	88	92	95	96	98									
7		17	39	60	72	81	87	91	94	96	97	98							
8		8	25	46	62	73	81	87	91	94	96	97	98						
9		3	15	32	50	63	73	80	85	90	93	95	97	98					
10			8	20	38	50	62	72	79	85	89	92	94	96	98				
11			4	13	25	39	52	63	72	79	84	88	91	94	96	97	98		
12				8	17	29	42	54	63	72	78	83	88	91	94	96	97	98	
13				5	11	20	32	44	54	65	72	78	83	88	91	93	95	97	98
14				2	8	15	24	34	45	56	64	71	78	83	88	91	93	95	97
15					5	10	18	27	37	48	57	65	72	79	84	88	91	93	95
16					3	7	13	21	29	40	49	58	66	73	79	83	87	91	93
17						4	9	15	22	32	40	49	58	66	73	78	83	87	91
18						3	6	11	16	22	32	40	49	58	66	72	78	83	87
19							3	7	11	18	24	32	40	50	58	65	71	77	82
20							2	5	8	13	18	22	32	41	50	57	64	71	77
21								3	5	9	13	18	24	32	40	47	55	62	70
22									3	6	9	13	18	22	32	38	46	54	62
23										4	6	9	13	17	23	29	36	44	52
24										2	4	6	9	12	17	22	28	34	42
25											2	4	6	9	12	16	20	26	32
26												2	4	6	9	11	15	19	24
27													2	3	5	8	10	14	18
28														2	3	5	7	9	13
29															2	3	5	7	9
30																	3	4	6

TABLE 33.—*Percentage distribution of cubic-foot volume in and above successive diameter classes in stands of different average diameter; all species combined*

Diameter class (inches)	Distribution (per cent) by average stand diameter																		
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches	19 inches	20 inches
1	100																		
2	98																		
3	82	93	96																
4	54	81	91	95	98														
5	26	64	82	90	95	97													
6	9	44	70	82	89	93	97												
7	2	26	54	72	82	89	94	96	98										
8		13	37	58	73	82	89	93	96	97									
9		5	24	42	60	72	82	88	92	95	97								
10		2	14	31	48	63	74	82	88	92	94	96	98						
11			7	20	34	50	64	74	81	87	91	94	96	98					
12			3	12	24	38	53	64	74	80	86	90	93	95	97				
13				7	16	28	42	54	64	73	79	86	89	93	95	97			
14				3	10	20	32	43	55	64	72	79	85	89	92	95	97	98	
15				2	6	13	23	33	44	54	64	72	78	84	88	92	94	96	98
16					3	9	17	26	36	45	55	64	72	78	84	88	92	94	96
17					2	5	11	18	27	36	46	55	63	71	77	83	88	91	94
18						2	7	13	20	28	36	46	54	64	71	77	82	87	91
19						2	4	8	14	20	28	36	45	54	62	70	76	82	86
20							2	5	9	15	21	28	36	46	52	62	69	76	81
21								3	6	9	15	20	28	36	44	52	60	68	74
22								2	3	6	10	15	21	28	36	44	52	60	68
23									2	4	7	11	16	22	28	35	43	51	59
24										2	4	7	10	15	20	27	34	42	50
25											2	4	7	11	15	20	26	34	41
26												2	4	7	10	15	20	25	32
27													2	4	6	9	13	18	23
28														2	3	5	8	12	16
29															2	3	5	8	11
30																2	3	4	6

TABLE 34.—*Percentage distribution of board-foot volume in and above successive diameter classes in stands of different average diameter; all species combined*

Diameter class (inches)	Distribution (per cent) by average stand diameter																
	2 inches	3 inches	4 inches	5 inches	6 inches	7 inches	8 inches	9 inches	10 inches	11 inches	12 inches	13 inches	14 inches	15 inches	16 inches	17 inches	18 inches
7	100	100	100	100	100	100	100	----	----	----	----	----	----	----	----	----	----
8	37	69	83	89	94	97	98	----	----	----	----	----	----	----	----	----	----
9	9	32	58	72	83	89	92	94	97	98	----	----	----	----	----	----	----
10	3	14	35	53	67	77	84	89	93	94	97	98	----	----	----	----	----
11	----	6	19	35	50	64	74	81	86	91	93	95	97	98	----	----	----
12	----	3	10	21	36	50	61	71	78	84	89	92	94	96	97	98	----
13	----	----	5	13	24	36	49	60	69	76	83	87	91	93	95	96	97
14	----	----	3	7	15	25	37	48	58	68	75	81	86	90	93	94	96
15	----	----	----	4	9	16	26	36	47	57	67	74	80	85	89	92	94
16	----	----	----	3	5	11	19	27	37	47	57	65	72	80	84	88	91
17	----	----	----	----	3	7	12	19	28	37	47	56	65	72	79	84	87
18	----	----	----	----	2	4	8	14	20	29	38	47	55	65	72	78	83
19	----	----	----	----	----	3	5	9	14	21	29	37	46	56	65	71	77
20	----	----	----	----	----	----	3	6	9	15	21	29	38	47	56	65	71
21	----	----	----	----	----	----	2	4	6	10	15	21	29	38	47	56	64
22	----	----	----	----	----	----	----	3	4	7	11	16	22	29	39	47	56
23	----	----	----	----	----	----	----	----	3	4	7	11	15	21	30	39	46
24	----	----	----	----	----	----	----	----	----	3	4	7	11	15	21	30	37
25	----	----	----	----	----	----	----	----	----	----	3	4	7	10	14	21	28
26	----	----	----	----	----	----	----	----	----	----	----	3	4	6	8	14	20
27	----	----	----	----	----	----	----	----	----	----	----	----	3	4	5	8	14

VOLUME TABLES

CUBIC-FOOT VOLUMES

Tables giving volumes of individual trees of the different species in the western white pine type are presented in the following pages.

TABLE 35.—*Cubic-foot volume table for second-growth western white pine*

Diameter breast high (inches)	Volume (cubic feet) by total height of trees in feet																				Basis (trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
1	0.02	0.04	0.07	0.10																	
2	.10	.20	.30	0.40	0.49	0.59															14
3	.23	.46	.68	.90	1.12	1.34															11
4		.82	1.20	1.60	2.00	2.40	2.80	3.10													16
5		1.24	1.90	2.50	3.10	3.70	4.32	4.94													46
6			2.7	3.6	4.4	5.3	6.2	7.0	7.8	8.7											28
7			4	5	6	7	8	9	10	12	13	14									53
8			5	6	8	9	11	12	14	15	17	18	20								63
9				8	10	12	14	15	17	19	21	23	25	27							56
10				10	12	14	17	19	21	23	26	28	30	32							46
11						17	20	23	25	28	31	33	36	39							55
12						21	24	27	30	33	36	39	43	46	49						59
13						24	28	31	35	38	42	46	50	53	56						51
14							32	36	40	44	48	52	56	60	64	68					46
15								41	46	50	55	59	64	68	73	77					40
16									52	57	62	67	72	77	82	87					33
17									58	63	69	74	80	86	92	97					31
18									64	70	77	83	89	95	101	107					10
19									70	77	84	90	97	104	111	118	123				17
20										85	92	99	106	114	122	129	136				4
21										93	101	108	116	125	133	141	149				12
22										102	110	118	127	136	145	153	162				10
23										110	119	128	137	147	157	166	175				5
24											130	140	149	158	168	179	188	199			3
25											139	149	159	170	181	191	201	212			
26											149	161	172	182	193	204	215	225			
27											159	172	184	195	206	217	229	240	251	263	1
28												184	196	208	219	231	243	255	268	280	1
29												195	208	220	232	245	258	271	284	298	
30												207	220	233	246	260	273	287	300	314	
31												218	232	247	260	275	290	304	318	332	
32												229	244	260	275	290	305	320	335	350	
Basis (trees)		15	16	27	48	38	55	66	80	88	81	74	58	38	24	2		1			711

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Volume includes peeled stump, stem, and top. Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, less than 0.5 per cent. Average deviation of individual tree volumes from tabular values 7.4 per cent.

TABLE 36.—*Cubic-foot volume table for second-growth western larch*

Diameter breast high (inches)	Volume (cubic feet) by total height of trees in feet																				Basis (trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
1	0.01	0.03	0.06																		
2		.13	.20	0.30																	
3		.35	.48	.67	0.84																3
4		.60	.92	1.20	1.54	1.90															4
5			1.51	1.90	2.48	2.95															11
6				2.8	3.6	4.2	4.8	5.5	6.3	7.2											13
7				3.9	4.8	5.7	6.6	7.6	8.6	9.6	10.5										12
8				5	6	8	9	10	11	13	14										25
9				6	8	10	11	13	14	16	18	19									22
10					10	12	14	16	17	19	21	23	25	27							11
11					12	14	16	19	21	23	26	28	30	33	35	37					32
12						17	19	22	25	27	30	33	36	38	41	44					22
13						20	23	26	29	32	35	38	42	45	48	51					22
14						22	26	29	33	36	40	44	48	51	54	58					28
15						25	29	33	37	41	45	49	54	58	62	66					13
16							33	38	42	46	50	55	60	65	69	73	78	83	87		17
17									46	52	57	62	67	72	76	81	86	91	96		18
18									51	57	63	68	74	79	84	89	94	99	105		15
19									57	64	70	75	81	87	92	98	103	109	114		10
20									63	70	76	82	89	95	100	106	112	119	125		14
21										76	83	90	96	103	109	116	122	129	135		15
22										83	90	97	104	111	118	125	132	139	146		11
23										90	97	105	112	120	127	134	142	150	158		3
24										97	105	113	121	129	137	144	152	161	169		2
25											112	121	129	138	146	155	163	172	181		5
26											120	129	138	147	156	165	174	183	192	201	5
27											127	137	147	157	166	176	185	194	203	212	4
28											135	145	156	166	176	186	196	206	216	225	1
29											142	153	165	176	186	197	207	217	228	238	2
30											150	162	174	186	197	208	218	229	240	251	
31												171	183	195	207	219	230	241	252	264	
32												180	193	205	218	230	241	252	264	278	1
Basis (trees)		1		7	11	24	21	24	28	33	43	24	37	32	35	17	2	2			341

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Volume includes peeled stump, stem, and top. Tree volumes computed by planimeter method. Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, —0.6 per cent. Average deviation oı individual tree volumes from tabular values, 8.4 per cent.

TABLE 37.—*Cubic-foot volume table for second-growth western hemlock*

Diameter breast high (inches)	Volume (cubic feet) by total height of trees in feet																Basis (trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
1	0.04	0.06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2	.13	.20	0.27	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	---	.46	.62	0.77	---	---	---	---	---	---	---	---	---	---	---	---	4
4	---	.82	1.09	1.37	---	---	---	---	---	---	---	---	---	---	---	---	2
5	---	1.28	1.68	2.12	---	---	---	---	---	---	---	---	---	---	---	---	2
6	---	1.8	2.4	3.1	3.7	4.4	---	---	---	---	---	---	---	---	---	---	1
7	---	2.0	3	4	5	6	7	8	---	---	---	---	---	---	---	---	1
8	---	3	4	5	7	8	9	11	---	---	---	---	---	---	---	---	1
9	---	---	---	7	9	10	12	14	16	18	---	---	---	---	---	---	3
10	---	---	---	8	11	13	15	17	19	22	---	---	---	---	---	---	2
11	---	---	---	---	13	15	18	20	23	26	---	---	---	---	---	---	1
12	---	---	---	---	15	18	21	24	28	31	---	---	---	---	---	---	2
13	---	---	---	---	18	22	25	29	33	36	40	---	---	---	---	---	2
14	---	---	---	---	21	25	29	33	38	42	47	51	---	---	---	---	4
15	---	---	---	---	24	29	33	38	43	48	54	59	---	---	---	---	6
16	---	---	---	---	28	33	38	43	49	55	61	67	74	80	88	---	11
17	---	---	---	---	31	37	43	49	55	62	69	76	83	90	98	---	5
18	---	---	---	---	34	41	48	55	62	69	77	85	93	101	110	---	5
19	---	---	---	---	38	45	53	61	69	77	86	94	103	112	122	---	7
20	---	---	---	---	---	---	58	67	76	85	95	104	114	124	134	---	3
21	---	---	---	---	---	---	64	74	84	94	105	115	126	136	147	159	6
22	---	---	---	---	---	---	70	81	92	103	114	126	137	149	161	174	---
23	---	---	---	---	---	---	77	89	101	112	124	137	150	163	176	190	2
24	---	---	---	---	---	---	---	---	109	122	135	149	163	177	191	206	1
25	---	---	---	---	---	---	---	---	119	132	146	161	176	191	207	223	---
26	---	---	---	---	---	---	---	---	128	143	159	174	190	206	223	240	1
27	---	---	---	---	---	---	---	---	---	---	---	187	204	222	240	259	---
28	---	---	---	---	---	---	---	---	---	---	---	200	220	239	259	279	---
29	---	---	---	---	---	---	---	---	---	---	---	215	236	257	278	299	---
30	---	---	---	---	---	---	---	---	---	---	---	230	252	274	297	320	---
Basis (trees)	---	7	2	---	4	3	3	3	13	8	14	9	5	1	---	---	72

Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Volume includes peeled stump, stem, and top. Tree volumes computed by planimeter method. Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.31 per cent. Average deviation of individual tree volumes from tabular values, 8.2 per cent.

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TABLE 38.—*Cubic-foot volume table for second-growth lowland white fir*

Diameter breast high (inches)	Volume (cubic feet) by total height of trees in feet																		Basis (trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
1	0.03	0.06																	
2	.12	.22	0.32	0.42															
3	.25	.47	.69	.91															14
4		.84	1.22	1.64	2.0	2.4													3
5		1.32	1.87	2.52	3.1	3.8													2
6			2.7	3.6	4.4	5.3	6	7	8										6
7			4	5	6	7	8	9	10										5
8			5	6	8	9	10	12	14	15	17								7
9			6	8	10	12	13	15	17	19	21								8
10				10	12	14	16	18	21	23	25								10
11					14	17	19	22	25	28	31								13
12						20	23	26	30	33	36								4
13						23	27	31	34	38	42	46	50	54					6
14						27	31	35	40	44	49	54	58	62					2
15						31	36	41	46	51	56	62	67	71					9
16							41	47	52	58	64	70	76	81					4
17							46	53	59	66	72	79	85	91	97				6
18							52	59	66	74	81	88	94	101	108				8
19									74	82	90	97	104	111	119	127			7
20									81	90	99	107	114	122	130	139			4
21									89	99	108	117	125	133	142	150			6
22									97	108	117	126	135	144	153	162			5
23									106	117	127	137	146	156	165	175	186	196	5
24									113	125	137	148	158	168	178	189	200	210	1
25									121	134	147	159	170	181	192	203	214	226	2
26											158	170	183	195	207	219	231	243	1
27											168	182	196	209	222	234	247	261	1
28											179	195	209	223	238	251	265	280	
29											190	207	222	237	253	269	284	299	
30											202	219	236	252	269	287	302	318	
Basis (trees)	1	15	3	5	5	8	10	12	18	17	9	16	13	3	4				139

Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Volume includes peeled stump, stem, and top. Tree volumes computed by planimeter method. Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.02 per cent. Average deviation of individual tree volumes from tabular values, 8.0 per cent.

TABLE 39.—*Cubic-foot volume table for second-growth Douglas fir*

Diameter, breast high (inches)	Volume (cubic feet) by total height of trees in feet																		Basis (trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
1	0.01	0.06	0.09	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
2	.09	.24	.32	0.42	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	----	.48	.67	.88	1.10	----	----	----	----	----	----	----	----	----	----	----	----	----	1
4	----	.80	1.15	1.51	1.88	2.2	2.6	----	----	----	----	----	----	----	----	----	----	----	6
5	----	1.20	1.75	2.31	2.82	3.4	4.0	----	----	----	----	----	----	----	----	----	----	----	26
6	----	----	2.5	3.3	4.0	4.8	5.6	6	7	----	----	----	----	----	----	----	----	----	23
7	----	----	3.4	4.4	5.4	6.4	7.4	8	9	----	----	----	----	----	----	----	----	----	19
8	----	----	4	6	7	8	10	11	12	13	15	----	----	----	----	----	----	----	46
9	----	----	----	7	9	10	12	14	15	17	18	----	----	----	----	----	----	----	30
10	----	----	----	9	11	13	15	16	18	20	22	----	----	----	----	----	----	----	19
11	----	----	----	----	13	15	17	20	22	24	26	28	30	----	----	----	----	----	37
12	----	----	----	----	15	18	20	23	26	28	31	33	36	----	----	----	----	----	25
13	----	----	----	----	17	20	24	27	30	33	35	38	41	----	----	----	----	----	23
14	----	----	----	----	20	24	27	30	34	38	41	45	48	----	----	----	----	----	26
15	----	----	----	----	22	27	31	35	39	43	46	50	54	----	----	----	----	----	21
16	----	----	----	----	----	30	35	39	44	48	52	57	61	66	70	74	----	----	12
17	----	----	----	----	----	----	39	44	49	54	58	63	68	73	78	82	----	----	11
18	----	----	----	----	----	----	43	49	54	60	65	71	76	81	86	91	----	----	8
19	----	----	----	----	----	----	----	54	60	66	72	78	84	90	96	101	----	----	9
20	----	----	----	----	----	----	----	59	66	72	79	86	92	99	105	111	----	----	5
21	----	----	----	----	----	----	----	64	72	79	86	94	101	108	115	121	----	----	9
22	----	----	----	----	----	----	----	70	78	86	94	102	110	118	126	132	----	----	2
23	----	----	----	----	----	----	----	76	85	94	103	112	120	128	137	144	----	----	4
24	----	----	----	----	----	----	----	82	91	101	111	121	130	139	148	156	----	----	3
25	----	----	----	----	----	----	----	88	99	110	120	130	140	149	159	168	----	----	1
26	----	----	----	----	----	----	----	95	106	118	129	140	150	160	170	179	----	----	1
27	----	----	----	----	----	----	----	102	114	126	138	150	161	172	182	192	----	----	----
28	----	----	----	----	----	----	----	110	122	135	148	160	172	183	195	206	217	228	----
29	----	----	----	----	----	----	----	----	130	144	158	171	183	196	208	220	232	243	----
30	----	----	----	----	----	----	----	----	138	154	168	182	195	208	221	235	248	260	1
31	----	----	----	----	----	----	----	----	----	164	179	193	207	221	235	250	264	276	----
32	----	----	----	----	----	----	----	----	----	174	189	204	219	235	250	266	281	294	----
Basis (trees)	----	----	3	22	42	41	51	58	61	48	28	9	2	2	1	----	----	----	368

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Volume includes peeled stump, stem, and top. Tree volumes computed by planimeter method. Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.6 per cent. Average deviation of individual tree volumes from tabular values, 9.9 per cent.

TABLE 40.—*Cubic-foot volume table for second-growth western red cedar*

Diamter, breast high (inches)	Volume (cubic feet) by total height of trees in feet																Basis (trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
1	0.02	0.05	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
2	.10	.20	0.31	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	----	.47	.67	0.91	----	----	----	----	----	----	----	----	----	----	----	----	1
4	----	.83	1.25	1.63	2.1	2.5	----	----	----	----	----	----	----	----	----	----	1
5	----	1.27	1.95	2.60	3.2	3.8	----	----	----	----	----	----	----	----	----	----	5
6	----	----	2.8	3.6	4.5	5.3	6	7	----	----	----	----	----	----	----	----	8
7	----	----	4	5	6	7	8	9	----	----	----	----	----	----	----	----	3
8	----	----	5	6	8	9	10	12	13	14	----	----	----	----	----	----	4
9	----	----	6	8	9	11	13	14	16	18	----	----	----	----	----	----	13
10	----	----	7	9	11	14	16	18	20	22	----	----	----	----	----	----	10
11	----	----	----	11	14	16	19	21	23	26	29	----	----	----	----	----	12
12	----	----	----	13	16	19	22	25	27	30	33	36	38	----	----	----	27
13	----	----	----	15	18	22	25	28	32	35	38	41	44	----	----	----	23
14	----	----	----	----	21	25	29	33	36	40	43	47	50	----	----	----	20
15	----	----	----	----	24	29	33	37	41	45	49	53	56	----	----	----	19
16	----	----	----	----	27	32	37	41	46	50	54	58	62	----	----	----	17
17	----	----	----	----	30	35	40	45	50	55	60	64	69	----	----	----	11
18	----	----	----	----	33	39	45	50	55	60	65	70	76	----	----	----	11
19	----	----	----	----	36	43	49	55	61	66	71	77	83	----	----	----	3
20	----	----	----	----	----	----	53	60	66	72	78	84	90	----	----	----	3
21	----	----	----	----	----	----	58	65	72	78	84	91	98	----	----	----	2
22	----	----	----	----	----	----	----	----	77	84	91	98	106	114	----	----	3
23	----	----	----	----	----	----	----	----	83	91	99	107	115	123	----	----	3
24	----	----	----	----	----	----	----	----	90	98	106	115	123	131	139	146	1
25	----	----	----	----	----	----	----	----	96	105	114	123	132	140	149	156	----
26	----	----	----	----	----	----	----	----	103	113	122	131	140	149	158	167	----
27	----	----	----	----	----	----	----	----	110	120	130	140	149	159	168	178	----
28	----	----	----	----	----	----	----	----	117	128	138	148	158	168	178	188	1
29	----	----	----	----	----	----	----	----	125	136	146	157	167	178	188	199	1
30	----	----	----	----	----	----	----	----	132	143	154	165	176	187	198	209	----
Basis (trees)	----	1	2	8	15	13	37	54	41	21	7	2	1	----	----	----	202

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Volume includes peeled stump, stem, and top. Tree volumes computed by planimeter method. Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.05 per cent. Average deviation of individual tree volumes from tabular values 8.0 per cent.

BOARD-FOOT VOLUMES, SCRIBNER RULE

TABLE 41.—*Board-foot volume table (Scribner rule—total height) for second-growth western white pine*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet																	Basis (trees)
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
8	9	17	24	32	40	48	55	62	69	76	----	----	----	----	----	----	----	62
9	20	30	40	50	60	68	78	86	96	108	117	----	----	----	----	----	----	56
10	31	43	56	68	80	90	105	115	125	140	150	----	----	----	----	----	----	46
11	---	---	72	87	100	115	130	145	155	170	185	----	----	----	----	----	----	55
12	---	---	88	105	125	140	155	175	190	210	225	240	----	----	----	----	----	59
13	---	---	105	125	145	165	185	205	225	245	265	285	----	----	----	----	----	51
14	---	---	----	145	170	190	215	240	260	285	310	330	360	----	----	----	----	46
15	---	---	----	----	190	220	250	275	305	330	355	380	410	----	----	----	----	40
16	---	---	----	----	----	250	285	320	345	380	410	435	465	----	----	----	----	33
17	---	---	----	----	----	290	325	360	395	430	460	495	525	----	----	----	----	31
18	---	---	----	----	----	325	370	410	445	480	515	550	595	----	----	----	----	10
19	---	---	----	----	----	365	410	455	495	540	580	615	670	705	----	----	----	17
20	---	---	----	----	----	----	460	510	550	600	645	690	740	790	----	----	----	4
21	---	---	----	----	----	----	510	565	615	665	715	765	820	870	----	----	----	12
22	---	---	----	----	----	----	560	620	675	740	790	845	905	960	----	----	----	10
23	---	---	----	----	----	----	615	680	740	810	865	930	990	1,050	----	----	----	5
24	---	---	----	----	----	----	----	745	810	880	945	1,010	1,070	1,140	1,200	----	----	3
25	---	---	----	----	----	----	----	810	880	955	1,020	1,090	1,160	1,220	1,300	----	----	----
26	---	---	----	----	----	----	----	875	950	1,030	1,100	1,170	1,250	1,310	1,390	----	----	----
27	---	---	----	----	----	----	----	940	1,020	1,100	1,180	1,250	1,340	1,410	1,490	1,560	1,640	1
28	---	---	----	----	----	----	----	----	1,090	1,180	1,260	1,340	1,430	1,500	1,590	1,660	1,750	1
29	---	---	----	----	----	----	----	----	1,160	1,250	1,350	1,430	1,520	1,600	1,690	1,770	1,850	----
30	---	---	----	----	----	----	----	----	1,240	1,330	1,430	1,520	1,610	1,700	1,790	1,870	1,950	----
31	---	---	----	----	----	----	----	----	1,310	1,410	1,510	1,610	1,710	1,800	1,890	1,970	2,050	----
32	---	---	----	----	----	----	----	----	1,380	1,490	1,590	1,700	1,800	1,890	1,980	2,060	2,140	----
Basis (trees)	---	3	10	33	51	79	88	81	74	58	38	24	2	----	1	----	----	542

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1 foot. Trees scaled in 16-foot log lengths with 0.25-foot trimming allowance and additional top section to 6-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.44 per cent. Average deviation of individual tree volumes from tabular values, 11.6 per cent.

125913°—32——4

TABLE 42.—*Board-foot volume table (Scribner rule—total height) for second-growth western larch*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet																Basis (trees)
	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
10	9	13	18	23	29	35	41	47	54	62	---	---	---	---	---	---	2
11	19	26	34	42	51	60	69	79	89	100	110	120	---	---	---	---	32
12	---	43	53	64	75	86	100	115	130	140	155	170	---	---	---	---	22
13	---	60	74	88	100	115	135	150	165	185	200	220	---	---	---	---	22
14	---	80	95	115	130	150	165	185	205	225	250	270	---	---	---	---	28
15	---	100	120	140	160	180	200	220	240	265	290	320	---	---	---	---	13
16	---	---	140	165	185	210	230	255	280	310	340	370	405	445	490	---	17
17	---	---	---	---	215	245	270	300	330	360	390	430	470	515	565	---	18
18	---	---	---	---	250	280	310	345	375	405	445	485	530	580	635	---	15
19	---	---	---	---	280	315	350	385	420	460	500	545	595	655	715	---	10
20	---	---	---	---	310	350	390	430	470	510	555	610	665	725	790	---	14
21	---	---	---	---	---	395	435	480	525	570	620	675	730	790	860	---	15
22	---	---	---	---	---	440	485	530	575	625	675	740	805	870	940	---	11
23	---	---	---	---	---	480	530	580	635	685	740	800	870	940	1,020	---	3
24	---	---	---	---	---	525	575	630	685	740	800	870	940	1,010	1,090	---	2
25	---	---	---	---	---	---	630	680	740	800	860	930	1,000	1,080	1,170	---	5
26	---	---	---	---	---	---	680	730	795	855	920	995	1,070	1,150	1,240	1,330	5
27	---	---	---	---	---	---	730	785	850	915	985	1,060	1,140	1,220	1,310	1,410	4
28	---	---	---	---	---	---	780	840	905	970	1,040	1,120	1,200	1,290	1,380	1,480	1
29	---	---	---	---	---	---	820	890	960	1,030	1,100	1,180	1,270	1,360	1,460	1,560	2
30	---	---	---	---	---	---	870	940	1,010	1,080	1,160	1,240	1,330	1,430	1,530	1,640	---
31	---	---	---	---	---	---	---	990	1,070	1,140	1,220	1,310	1,400	1,490	1,600	1,710	---
32	---	---	---	---	---	---	---	1,040	1,120	1,200	1,280	1,370	1,470	1,570	1,670	1,780	1
Basis (trees)	---	---	4	6	19	24	40	24	37	32	35	17	2	2	---	---	242

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths, with 0.3 -foot trimming allowance, and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.7 per cent. Average deviation of individual tree volumes from tabular values, 15.7 per cent.

TABLE 43.—*Board-foot volume table (Scribner rule—total height) for second-growth western hemlock*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet													Basis (trees)
	40	50	60	70	80	90	100	110	120	130	140	150	160	
10	15	24	33	41	49	57	65	---	---	---	---	---	---	2
11	---	38	49	60	70	81	91	---	---	---	---	---	---	1
12	---	52	65	80	92	105	120	---	---	---	---	---	---	2
13	---	66	83	100	115	135	155	175	---	---	---	---	---	2
14	---	80	100	125	145	165	190	210	235	---	---	---	---	4
15	---	95	120	150	175	200	230	255	280	---	---	---	---	6
16	---	110	140	170	200	230	265	295	330	360	390	420	---	11
17	---	125	165	200	235	270	305	340	380	415	450	490	---	5
18	---	145	185	225	265	305	350	390	430	475	515	560	---	5
19	---	160	210	255	300	345	395	445	490	540	585	635	---	7
20	---	---	---	290	340	390	450	500	555	610	660	720	---	3
21	---	---	---	325	380	440	505	565	625	690	750	810	875	6
22	---	---	---	360	430	495	565	630	700	770	840	915	990	---
23	---	---	---	405	480	550	630	705	780	860	940	1,020	1,100	2
24	---	---	---	---	---	610	700	780	865	955	1,040	1,130	1,220	1
25	---	---	---	---	---	675	770	865	955	1,050	1,150	1,250	1,350	---
26	---	---	---	---	---	740	845	950	1,050	1,150	1,250	1,360	1,470	1
27	---	---	---	---	---	---	---	---	1,140	1,260	1,370	1,480	1,600	---
28	---	---	---	---	---	---	---	---	1,240	1,370	1,490	1,610	1,740	---
29	---	---	---	---	---	---	---	---	1,340	1,480	1,610	1,740	1,890	---
30	---	---	---	---	---	---	---	---	1,460	1,600	1,750	1,890	2,040	---
Basis (trees)	---	---	3	2	3	13	8	14	9	5	1	---	---	58

Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16 foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, —0.23 per cent. Average deviation of individual tree volumes from tabular values, 11.8 per cent.

TABLE 44.—*Board-foot volume table (Scribner rule—total height) for second-growth lowland white fir*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet															Basis (trees)
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
10	13	18	24	31	37	45	53	60	----	----	----	----	----	----	----	8
11	----	37	46	55	64	74	85	96	----	----	----	----	----	----	----	13
12	----	----	70	82	95	110	125	140	----	----	----	----	----	----	----	4
13	----	----	95	110	125	145	160	180	200	220	240	----	----	----	----	6
14	----	----	120	140	160	180	200	225	250	270	295	----	----	----	----	2
15	----	----	145	170	195	220	245	270	295	320	350	----	----	----	----	9
16	----	----	----	200	230	260	290	320	350	380	415	----	----	----	----	4
17	----	----	----	235	265	300	340	370	405	440	480	515	----	----	----	6
18	----	----	----	265	305	345	385	425	465	505	545	590	----	----	----	8
19	----	----	----	----	----	390	440	480	525	570	620	660	705	----	----	7
20	----	----	----	----	----	440	500	540	590	640	690	740	790	----	----	4
21	----	----	----	----	----	495	555	605	655	715	770	825	880	----	----	6
22	----	----	----	----	----	555	615	670	730	790	850	910	970	----	----	5
23	----	----	----	----	----	610	680	740	800	870	940	1,000	1,060	1,130	1,190	5
24	----	----	----	----	----	670	745	810	875	950	1,020	1,090	1,160	1,230	1,290	1
25	----	----	----	----	----	730	810	880	950	1,030	1,110	1,180	1,250	1,330	1,400	2
26	----	----	----	----	----	----	----	950	1,030	1,110	1,190	1,270	1,350	1,430	1,500	1
27	----	----	----	----	----	----	----	1,020	1,110	1,200	1,280	1,370	1,450	1,530	1,610	1
28	----	----	----	----	----	----	----	1,100	1,190	1,280	1,380	1,470	1,560	1,640	1,720	----
29	----	----	----	----	----	----	----	1,170	1,270	1,370	1,470	1,560	1,660	1,740	1,820	----
30	----	----	----	----	----	----	----	1,240	1,350	1,460	1,560	1,660	1,760	1,850	1,930	----
Basis (trees)	----	----	1	4	8	17	17	9	16	13	3	4	----	----	----	92

Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, —0.18 per cent. Average deviation of individual tree volumes from tabular values, 15.8 per cent.

TABLE 45.—*Board-foot volume table (Scribner rule—total height) for second-growth Douglas fir*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet															Basis (trees)
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
10	1	4	9	14	23	31	40	48	----	----	----	----	----	----	----	17
11	----	12	21	34	46	60	70	83	98	110	----	----	----	----	----	37
12	----	23	36	54	70	88	105	120	135	150	----	----	----	----	----	25
13	----	35	55	76	95	115	135	155	175	190	----	----	----	----	----	23
14	----	49	74	99	120	145	170	190	215	235	----	----	----	----	----	26
15	----	65	94	120	145	175	205	230	255	275	----	----	----	----	----	21
16	----	----	115	145	175	205	235	265	290	320	350	375	400	----	----	12
17	----	----	----	170	205	240	270	305	335	365	390	420	450	----	----	11
18	----	----	----	195	230	270	305	340	375	410	440	470	500	----	----	8
19	----	----	----	----	260	300	340	380	420	450	485	525	560	----	----	9
20	----	----	----	----	290	335	380	425	460	500	540	580	615	----	----	5
21	----	----	----	----	325	370	420	465	510	555	595	640	680	----	----	9
22	----	----	----	----	355	405	460	510	560	605	650	700	740	----	----	2
23	----	----	----	----	390	445	500	555	610	660	710	760	810	----	----	4
24	----	----	----	----	425	485	545	605	660	715	770	825	875	----	----	3
25	----	----	----	----	455	520	585	650	710	770	825	885	940	----	----	1
26	----	----	----	----	490	560	630	700	760	820	885	950	1,010	----	----	1
27	----	----	----	----	530	605	680	750	810	880	940	1,010	1,080	----	----	----
28	----	----	----	----	565	645	725	800	865	940	1,000	1,080	1,140	1,210	1,280	----
29	----	----	----	----	----	685	770	850	920	1,000	1,070	1,140	1,210	1,280	1,360	----
30	----	----	----	----	----	730	815	900	975	1,060	1,130	1,210	1,280	1,360	1,440	1
31	----	----	----	----	----	----	860	950	1,030	1,120	1,200	1,280	1,350	1,430	1,520	----
32	----	----	----	----	----	----	910	1,000	1,090	1,180	1,260	1,340	1,430	1,510	1,600	----
Basis (trees)	----	----	8	19	40	58	48	28	9	2	2	1	----	----	----	215

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths, with 0.3-foot trimming allowance, and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.7 per cent. Average deviation of individual tree volumes from tabular values, 23.3 per cent.

TABLE 46.—*Board-foot volume table (Scribner rule—total height) for second-growth western red cedar*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet														Basis (trees)
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
10	4	10	16	22	28	34	40	47	---	---	---	---	---	---	7
11	---	21	28	36	44	53	62	72	83	---	---	---	---	---	12
12	---	32	42	53	64	76	89	100	115	130	145	---	---	---	26
13	---	43	56	70	86	100	115	130	145	165	180	---	---	---	23
14	---	---	71	88	105	125	140	160	175	195	215	---	---	---	20
15	---	---	87	105	125	145	165	185	210	230	250	---	---	---	19
16	---	---	100	125	150	170	190	215	240	260	285	---	---	---	17
17	---	---	120	145	170	195	220	245	270	295	320	---	---	---	11
18	---	---	135	160	190	215	245	270	300	325	355	---	---	---	11
19	---	---	150	185	215	240	270	300	330	360	395	---	---	---	3
20	---	---	---	---	235	270	300	330	365	400	435	---	---	---	3
21	---	---	---	---	260	295	330	365	400	440	480	---	---	---	2
22	---	---	---	---	---	---	360	395	435	480	520	565	---	---	3
23	---	---	---	---	---	---	390	430	475	520	565	610	---	---	3
24	---	---	---	---	---	---	425	465	510	560	610	660	710	765	1
25	---	---	---	---	---	---	455	500	550	600	650	705	760	820	---
26	---	---	---	---	---	---	490	535	585	640	700	755	815	875	---
27	---	---	---	---	---	---	520	570	625	680	740	800	865	930	---
28	---	---	---	---	---	---	555	605	665	725	785	850	920	990	1
29	---	---	---	---	---	---	585	645	705	770	835	900	975	1,050	1
30	---	---	---	---	---	---	620	680	750	815	880	950	1,030	1,110	---
Basis (trees)	---	---	---	4	34	53	41	21	7	2	1	---	---	---	163

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, less than 1 per cent. Average deviation of individual tree volumes from tabular values, 15.6 per cent.

TABLE 47.—*Board-foot volume table (Scribner decimal C rule) for second-growth western white pine*

Diameter breast high (inches)	Volume (board feet in tens) by total number of 16-foot logs										Basis (trees)
	1¼	2	3	4	5	6	7	8	9	10	
8	2	4	7	10	13	---	---	---	---	---	61
9	2	4	8	11	14	---	---	---	---	---	56
10	3	5	9	12	16	20	---	---	---	---	46
11	3	5	10	14	18	22	---	---	---	---	55
12	3	6	11	15	20	24	29	---	---	---	59
13	4	7	12	17	22	27	32	---	---	---	51
14	4	7	13	19	25	30	36	41	---	---	46
15	4	8	15	21	27	33	40	45	---	---	40
16	---	---	---	23	30	37	44	50	57	64	33
17	---	---	---	25	33	41	48	56	63	71	31
18	---	---	---	28	36	45	54	62	70	78	10
19	---	---	---	30	40	49	59	68	77	86	17
20	---	---	---	33	44	54	65	75	85	95	4
21	---	---	---	36	48	59	71	82	93	105	12
22	---	---	---	39	52	64	78	90	100	115	10
23	---	---	---	42	57	70	85	98	110	125	5
24	---	---	---	46	61	76	92	105	120	135	3
25	---	---	---	50	66	82	100	115	130	145	---
26	---	---	---	54	71	89	110	125	140	160	---
27	---	---	---	58	77	95	115	135	155	170	1
28	---	---	---	62	82	105	125	145	165	185	1
29	---	---	---	66	88	110	130	155	175	195	---
30	---	---	---	70	94	115	140	165	185	210	---
31	---	---	---	75	100	125	150	175	200	220	---
32	---	---	---	79	105	135	160	185	210	235	---
Basis (trees)	15	77	85	124	108	82	41	9	---	---	541

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1 foot. Trees scaled in 16-foot log lengths with 0.25-foot trimming allowance and additional top section to 6-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.13 per cent. Average deviation of individual tree volumes from tabular values, 8.5 per cent.

TABLE 48.—*Board-foot volume table (Scribner decimal C rule) for second-growth western larch*

Diameter breast high (inches)	Volume (board feet in tens) by total number of 16-foot logs										Basis (trees)
	1¼	2	3	4	5	6	7	8	9	10	
10	4	6	10	------	------	------	------	------	------	------	2
11	4	7	11	15	19	------	------	------	------	------	24
12	5	7	12	17	21	25	------	------	------	------	22
13	5	8	14	19	23	28	32	------	------	------	21
14	5	9	15	20	26	31	35	------	------	------	28
15	6	9	16	22	28	34	39	------	------	------	13
16	------	10	17	24	30	37	42	48	------	------	17
17	------	11	18	26	33	40	46	52	------	------	18
18	------	12	20	28	35	43	50	57	------	------	15
19	------	------	21	30	38	47	54	62	------	------	10
20	------	------	22	32	41	50	58	67	75	83	14
21	------	------	------	34	44	54	63	73	82	91	15
22	------	------	------	37	48	58	68	79	89	99	11
23	------	------	------	40	51	63	73	85	96	105	3
24	------	------	------	42	55	68	79	92	105	115	2
25	------	------	------	45	59	72	85	99	110	125	5
26	------	------	------	48	62	77	91	105	120	135	5
27	------	------	------	51	66	82	97	115	130	145	4
28	------	------	------	54	71	88	105	120	135	150	1
29	------	------	------	57	75	93	110	130	145	160	2
30	------	------	------	60	79	99	120	135	155	170	------
31	------	------	------	63	84	105	125	145	165	180	------
32	------	------	------	67	88	110	130	150	170	190	1
Basis (trees)	12	27	25	43	45	42	31	8	------	------	233

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.25 per cent. Average deviation of individual tree volumes from tabular values, 8.2 per cent.

TABLE 49.—*Board-foot volume table (Scribner decimal C rule) for second-growth western hemlock*

Diameter breast high (inches)	Volume (board feet in tens) by total number of 16-foot logs								Basis (trees)
	1¼	2	3	4	5	6	7	8	
10	4	8	13	------	------	------	------	------	2
11	5	8	14	------	------	------	------	------	1
12	5	9	15	------	------	------	------	------	2
13	6	10	17	24	------	------	------	------	2
14	6	11	19	26	34	------	------	------	4
15	7	12	20	29	37	46	------	------	6
16	7	12	22	31	41	50	58	------	11
17	8	13	23	34	44	54	63	------	5
18	8	14	25	37	48	59	69	------	5
19	------	15	27	40	52	64	75	------	7
20	------	16	29	43	56	70	82	------	3
21	------	17	31	46	61	75	89	------	6
22	------	19	34	50	66	82	96	------	------
23	------	------	36	54	71	88	105	------	2
24	------	------	39	58	76	95	115	------	1
25	------	------	42	62	82	100	120	------	------
26	------	------	------	66	88	110	130	155	1
27	------	------	------	70	94	120	140	165	------
28	------	------	------	74	100	125	150	175	------
29	------	------	------	79	105	135	160	190	------
30	------	------	------	84	115	145	170	200	------
Basis (trees)	3	5	13	18	15	4	------	------	58

Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.06 per cent. Average deviation of individual tree volumes from tabular values, 8.6 per cent.

TABLE 50.—*Board-foot volume table (Scribner decimal C rule) for second-growth lowland white fir*

Diameter breast high (inches)	Volume (board feet in tens) by total number of 16-foot logs								Basis (trees)
	1¼	2	3	4	5	6	7	8	
10	4	7	12	-------	-------	-------	-------	-------	6
11	4	8	13	18	-------	-------	-------	-------	12
12	5	8	14	20	26	-------	-------	-------	4
13	5	9	16	22	29	-------	-------	-------	6
14	6	10	17	25	32	39	-------	-------	2
15	-------	11	19	27	35	42	-------	-------	9
16	-------	12	20	29	38	46	-------	-------	4
17	-------	12	22	32	41	50	59	68	6
18	-------	13	24	34	45	55	64	74	8
19	-------	14	26	37	49	60	70	81	7
20	-------	15	28	40	53	66	77	88	4
21	-------	-------	30	43	57	71	84	96	6
22	-------	-------	32	47	62	77	91	105	5
23	-------	-------	34	50	67	83	98	115	5
24	-------	-------	36	54	72	90	105	125	1
25	-------	-------	39	58	77	96	115	135	2
26	-------	-------	-------	-------	83	105	125	145	1
27	-------	-------	-------	-------	88	110	130	155	1
28	-------	-------	-------	-------	94	120	140	165	-------
29	-------	-------	-------	-------	100	125	150	175	-------
30	-------	-------	-------	-------	105	135	160	190	-------
Basis (trees)	6	11	16	12	20	15	9	-------	89

Block indicates extent of basic data. Data collected principally on the Cœur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.14 per cent. Average deviation of individual tree volumes from tabular values, 8.2 per cent.

TABLE 51.—*Board-foot volume table (Scribner decimal C rule) for second-growth Douglas fir*

Diameter breast high (inches)	Volume (board feet in tens) by total number of 16-foot logs								Basis (trees)
	1¼	2	3	4	5	6	7	8	
10	4	7	11	-------	-------	-------	-------	-------	5
11	4	7	12	16	-------	-------	-------	-------	32
12	5	8	13	18	-------	-------	-------	-------	24
13	5	8	14	20	25	-------	-------	-------	23
14	5	9	15	22	28	34	-------	-------	26
15	6	10	17	24	30	37	-------	-------	21
16	-------	10	18	26	33	40	47	-------	12
17	-------	11	19	28	36	44	51	-------	11
18	-------	12	21	30	39	47	55	-------	8
19	-------	13	22	32	42	51	60	-------	9
20	-------	13	24	35	45	55	65	-------	5
21	-------	-------	26	37	49	60	70	80	9
22	-------	-------	28	40	53	65	76	87	2
23	-------	-------	30	43	57	70	82	95	4
24	-------	-------	32	46	61	75	88	100	3
25	-------	-------	34	49	65	80	95	110	1
26	-------	-------	36	52	69	86	100	120	1
27	-------	-------	38	56	73	92	110	125	-------
28	-------	-------	40	59	78	98	115	135	-------
29	-------	-------	43	63	83	105	125	145	-------
30	-------	-------	46	66	88	110	130	155	1
31	-------	-------	48	70	93	115	140	165	-------
32	-------	-------	51	74	98	125	150	170	-------
Basis (trees)	21	54	59	41	18	3	1	-------	197

Block indicates extent of basic data. Data collected throughout the western white-pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −1.0 per cent. Average deviation of individual tree volumes from tabular values, 9.8 per cent.

TABLE 52.—*Board-foot volume table (Scribner decimal C rule) for second-growth western red cedar*

Diameter breast high (inches)	Volume (board feet in tens) by total number of 16-foot logs						Basis (trees)
	1¼	2	3	4	5	6	
10	4	7	--------	--------	--------	--------	4
11	4	7	12	16	--------	--------	10
12	5	8	13	18	23	--------	25
13	5	9	15	20	25	--------	23
14	6	10	16	22	27	--------	20
15	6	10	17	24	30	--------	19
16	6	11	18	25	32	--------	17
17	7	12	20	27	35	--------	11
18	7	12	21	30	38	--------	11
19	8	13	22	32	41	--------	3
20	8	14	24	34	44	--------	3
21	--------	15	26	37	48	58	2
22	--------	16	28	40	51	63	3
23	--------	--------	30	42	55	68	3
24	--------	--------	32	45	59	73	1
25	--------	--------	34	48	63	78	--------
26	--------	--------	36	51	67	83	--------
27	--------	--------	38	55	71	88	--------
28	--------	--------	40	58	76	93	1
29	--------	--------	42	61	80	99	1
30	--------	--------	45	64	85	105	--------
Basis (trees)	18	52	58	23	6	--------	157

Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 8-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.35 per cent. Average deviation of individual tree volumes from tabular values, 6.7 per cent.

BOARD-FOOT VOLUMES, INTERNATIONAL RULE

TABLE 53.—*Board-foot volume table (international rule) for second-growth western white pine*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet																	Basis (trees)
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
7	13	18	24	30	36	42	48	53	58	----	----	----	----	----	----	----	----	51
8	21	30	38	47	56	65	74	83	91	99	----	----	----	----	----	----	----	63
9	30	42	54	66	78	91	100	115	130	140	150	----	----	----	----	----	----	56
10	39	56	72	88	100	120	135	150	165	180	195	----	----	----	----	----	----	46
11	----	----	90	110	130	150	165	185	205	220	240	----	----	----	----	----	----	55
12	----	----	110	135	160	180	200	225	250	270	290	310	----	----	----	----	----	59
13	----	----	130	160	185	215	240	265	290	320	345	370	----	----	----	----	----	51
14	----	----	----	184	220	250	280	310	340	370	400	430	460	----	----	----	----	46
15	----	----	----	----	250	290	325	360	395	430	460	495	530	----	----	----	----	40
16	----	----	----	----	----	330	370	410	450	485	525	560	605	----	----	----	----	33
17	----	----	----	----	----	370	415	460	505	545	590	635	680	----	----	----	----	31
18	----	----	----	----	----	420	470	520	570	615	660	710	760	----	----	----	----	10
19	----	----	----	----	----	465	520	575	630	685	740	790	845	900	----	----	----	17
20	----	----	----	----	----	----	575	640	700	755	815	875	935	1,000	----	----	----	4
21	----	----	----	----	----	----	635	700	765	830	900	965	1,030	1,090	----	----	----	12
22	----	----	----	----	----	----	700	770	840	910	980	1,050	1,120	1,190	----	----	----	10
23	----	----	----	----	----	----	760	835	915	990	1,060	1,140	1,220	1,290	----	----	----	5
24	----	----	----	----	----	----	----	910	995	1,080	1,150	1,230	1,310	1,380	1,450	----	----	3
25	----	----	----	----	----	----	----	985	1,080	1,160	1,240	1,320	1,410	1,490	1,550	----	----	----
26	----	----	----	----	----	----	----	1,060	1,160	1,250	1,330	1,410	1,500	1,590	1,660	----	----	----
27	----	----	----	----	----	----	----	1,140	1,240	1,330	1,420	1,510	1,610	1,700	1,780	1,870	1,950	1
28	----	----	----	----	----	----	----	----	1,320	1,420	1,520	1,610	1,710	1,810	1,900	1,990	2,060	1
29	----	----	----	----	----	----	----	----	1,400	1,500	1,610	1,710	1,820	1,920	2,010	2,100	2,180	----
30	----	----	----	----	----	----	----	----	1,480	1,590	1,700	1,810	1,930	2,040	2,130	2,220	2,300	----
31	----	----	----	----	----	----	----	----	1,560	1,680	1,800	1,920	2,040	2,160	2,250	2,340	2,430	----
32	----	----	----	----	----	----	----	----	1,650	1,770	1,910	2,040	2,160	2,270	2,380	2,480	2,570	----
Basis (trees)	4	14	20	46	64	80	88	81	74	58	38	24	2	----	1	----	----	594

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1 foot. Trees scaled in 16-foot log lengths with 0.25-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from baisc data, —0.25 per cent. Average deviation of individual tree volumes from tabular values, 11.1 per cent.

Table 54.—*Board-foot volume table (international rule), for second-growth western larch*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet																	Basis (trees)
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	
7	6	10	14	19	24	29	35	40										8
8	11	18	25	32	40	48	56	64										24
9	18	28	38	48	58	69	79	89	100									22
10		38	53	66	79	92	105	115	130	145	155							11
11		51	68	85	100	115	135	150	165	180	195	210	220					32
12			86	105	125	145	165	180	200	220	240	255	275					22
13			105	130	150	175	195	215	240	260	285	305	330					22
14			125	150	180	205	230	255	280	305	330	360	390					28
15			145	175	205	240	270	300	330	355	385	415	450					13
16				200	235	275	305	340	375	410	440	475	510	545	580	610		17
17						315	350	385	425	460	500	535	575	615	655	690		18
18						355	395	435	480	520	560	600	640	690	730	770		15
19						395	440	485	530	580	625	670	715	770	815	850		10
20						440	490	540	590	640	690	740	785	840	890	930		14
21							545	595	655	710	760	810	865	925	980	1,020		15
22							595	655	715	775	835	890	945	1,010	1,070	1,120		11
23							650	715	780	845	905	960	1,020	1,090	1,150	1,210		3
24							710	770	840	910	975	1,040	1,110	1,180	1,240	1,300		2
25								830	910	980	1,050	1,120	1,190	1,270	1,340	1,400		5
26								890	980	1,050	1,130	1,200	1,280	1,350	1,430	1,500	1,560	5
27								955	1,050	1,130	1,210	1,290	1,370	1,450	1,520	1,590	1,650	4
28								1,020	1,110	1,200	1,290	1,370	1,450	1,540	1,620	1,690	1,750	1
29								1,080	1,180	1,280	1,370	1,460	1,540	1,630	1,710	1,790	1,850	2
30								1,150	1,260	1,360	1,450	1,540	1,630	1,720	1,810	1,890	1,960	
31									1,340	1,440	1,530	1,630	1,720	1,810	1,900	1,980	2,060	
32									1,420	1,520	1,620	1,720	1,820	1,910	2,000	2,080	2,160	1
Basis (trees)		2	11	17	22	28	33	43	24	37	32	35	17	2	2			305

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white-pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths, with 0.3-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.39 per cent. Average deviation of individual tree volumes from tabular values, 12.2 per cent.

TABLE 55.—*Board-foot volume table (international rule) for second-growth western hemlock*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet														Basis (trees)
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
7	7	11	15	20	25	31	----	----	----	----	----	----	----	----	1
8	10	17	24	32	40	48	----	----	----	----	----	----	----	----	1
9	----	25	35	45	56	68	80	92	----	----	----	----	----	----	3
10	----	33	46	60	74	89	105	120	----	----	----	----	----	----	2
11	----	----	59	76	95	115	135	150	----	----	----	----	----	----	1
12	----	----	74	95	115	140	165	185	----	----	----	----	----	----	2
13	----	----	90	115	140	170	195	220	245	----	----	----	----	----	2
14	----	----	110	140	170	200	230	260	295	330	----	----	----	----	4
15	----	----	130	165	200	235	275	310	345	385	----	----	----	----	6
16	----	----	145	190	230	275	315	360	400	445	485	525	565	----	11
17	----	----	165	215	265	310	360	410	455	505	550	600	650	----	5
18	----	----	190	245	300	355	410	465	515	570	625	680	740	----	5
19	----	----	210	275	335	400	460	525	580	640	700	765	830	----	7
20	----	----	----	----	370	445	515	585	650	720	790	860	930	----	3
21	----	----	----	----	415	495	575	655	725	800	880	960	1,040	1,120	6
22	----	----	----	----	455	550	640	725	805	885	970	1,060	1,150	1,240	----
23	----	----	----	----	505	605	700	795	885	975	1,070	1,170	1,270	1,360	2
24	----	----	----	----	----	----	770	870	970	1,070	1,170	1,280	1,390	1,490	1
25	----	----	----	----	----	----	840	950	1,060	1,170	1,280	1,390	1,510	1,620	----
26	----	----	----	----	----	----	915	1,040	1,150	1,270	1,390	1,510	1,640	1,760	1
27	----	----	----	----	----	----	----	----	----	1,380	1,510	1,640	1,770	1,910	----
28	----	----	----	----	----	----	----	----	----	1,490	1,630	1,770	1,910	2,060	----
29	----	----	----	----	----	----	----	----	----	1,600	1,750	1,900	2,050	2,210	----
30	----	----	----	----	----	----	----	----	----	1,720	1,880	2,040	2,200	2,380	----
Basis (trees)	----	----	4	3	3	3	13	8	14	9	5	1	----	----	63

One-eighth inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths, with 0.3-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.44 per cent. Average deviation of individual tree volumes from tabular values, 10.3 per cent.

TABLE 56.—*Board-foot volume table (international rule) for second-growth lowland white fir*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet																Basis (trees)
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
7	4	10	16	23	30	36	44	----	----	----	----	----	----	----	----	----	4
8	9	18	28	37	47	57	66	75	83	----	----	----	----	----	----	----	7
9	15	27	40	53	66	79	92	105	115	----	----	----	----	----	----	----	8
10	----	37	54	70	86	100	120	135	150	----	----	----	----	----	----	----	10
11	----	----	68	89	110	130	150	170	185	----	----	----	----	----	----	----	13
12	----	----	----	110	135	155	180	205	230	----	----	----	----	----	----	----	4
13	----	----	----	130	160	190	220	250	275	300	330	360	----	----	----	----	6
14	----	----	----	155	190	220	260	290	320	355	390	425	----	----	----	----	2
15	----	----	----	180	220	260	300	340	375	415	455	490	----	----	----	----	9
16	----	----	----	----	255	300	345	390	430	475	520	565	----	----	----	----	4
17	----	----	----	----	290	340	390	440	490	540	590	640	690	----	----	----	6
18	----	----	----	----	325	385	440	500	555	615	670	725	780	----	----	----	8
19	----	----	----	----	----	----	495	560	620	685	750	810	870	940	----	----	7
20	----	----	----	----	----	----	550	620	690	765	835	900	970	1,050	----	----	4
21	----	----	----	----	----	----	610	685	760	840	920	990	1,070	1,150	----	----	6
22	----	----	----	----	----	----	665	750	830	920	1,000	1,090	1,170	1,260	----	----	5
23	----	----	----	----	----	----	720	815	900	995	1,090	1,180	1,270	1,360	1,450	1,540	5
24	----	----	----	----	----	----	770	870	970	1,070	1,170	1,260	1,360	1,450	1,550	1,650	1
25	----	----	----	----	----	----	820	930	1,030	1,140	1,240	1,350	1,450	1,550	1,650	1,750	2
26	----	----	----	----	----	----	----	----	1,090	1,210	1,320	1,430	1,540	1,640	1,750	1,850	1
27	----	----	----	----	----	----	----	----	1,150	1,280	1,390	1,500	1,620	1,730	1,840	1,950	1
28	----	----	----	----	----	----	----	----	1,200	1,340	1,460	1,580	1,700	1,820	1,940	2,050	----
29	----	----	----	----	----	----	----	----	1,250	1,400	1,520	1,640	1,770	1,900	2,020	2,140	----
30	----	----	----	----	----	----	----	----	1,300	1,450	1,570	1,700	1,830	1,970	2,100	2,220	----
Basis (trees)	----	2	2	8	9	12	18	17	9	16	13	3	4	----	----	----	113

One-eighth inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, −0.59 per cent. Average deviation of individual tree volumes from tabular values, 13.6 per cent.

TABLE 57.—*Board-foot volume table (international rule) for second-growth Douglas fir*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet																Basis (trees)
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
7	1	8	14	20	25	30	36	------	------	------	------	------	------	------	------	------	18
8	9	16	24	32	39	48	56	63	69	------	------	------	------	------	------	------	46
9	---	24	34	45	56	66	77	86	94	------	------	------	------	------	------	------	30
10	---	33	46	59	73	86	100	110	125	------	------	------	------	------	------	------	19
11	---	---	57	74	90	110	125	140	155	170	185	------	------	------	------	------	37
12	---	---	69	90	110	130	150	165	185	205	225	------	------	------	------	------	25
13	---	---	84	105	130	155	180	200	220	245	265	------	------	------	------	------	23
14	---	---	100	125	155	180	205	235	260	285	310	------	------	------	------	------	26
15	---	---	115	150	180	210	240	270	300	330	360	------	------	------	------	------	21
16	---	---	----	170	205	240	275	310	345	380	410	445	480	515	------	------	12
17	---	---	----	----	230	275	315	350	385	425	465	505	545	585	------	------	11
18	---	---	----	----	260	305	350	395	435	485	525	565	610	655	------	------	8
19	---	---	----	----	----	340	390	440	485	535	580	630	675	725	------	------	9
20	---	---	----	----	----	380	435	490	540	595	645	695	750	805	------	------	5
21	---	---	----	----	----	420	480	540	595	655	710	765	820	885	------	------	9
22	---	---	----	----	----	460	525	590	655	720	780	840	900	970	------	------	2
23	---	---	----	----	----	500	575	645	715	785	850	915	985	1,060	------	------	4
24	---	---	----	----	----	545	625	700	770	850	920	995	1,070	1,150	------	------	3
25	---	---	----	----	----	590	675	755	830	920	995	1,070	1,150	1,240	------	------	1
26	---	---	----	----	----	635	725	815	895	985	1,070	1,160	1,250	1,340	------	------	1
27	---	---	----	----	----	680	780	870	960	1,060	1,150	1,240	1,340	1,430	------	------	----
28	---	---	----	----	----	730	835	940	1,030	1,140	1,240	1,340	1,440	1,540	1,640	1,740	----
29	---	---	----	----	----	----	890	1,000	1,100	1,210	1,320	1,430	1,540	1,640	1,740	1,850	----
30	---	---	----	----	----	----	950	1,070	1,180	1,300	1,410	1,520	1,640	1,750	1,860	1,980	1
31	---	---	----	----	----	----	----	1,130	1,250	1,380	1,500	1,620	1,750	1,860	1,980	2,100	----
32	---	---	----	----	----	----	----	1,200	1,330	1,460	1,590	1,720	1,850	1,980	2,110	2,240	----
Basis (trees)	---	5	20	27	50	58	61	48	28	9	2	2	1	------	------	------	311

One eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths, with 0.3-foot trimming allowance, and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, less than 0.5 per cent. Average deviation of individual tree volumes from tabular values, 15.4 per cent.

TABLE 58.—*Board-foot volume table (international rule) for second-growth western red cedar*

Diameter breast high (inches)	Volume (board feet) by total height of trees in feet														Basis (trees)
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	
7	9	14	19	24	29	33	----	----	----	----	----	----	----	----	3
8	14	20	27	34	42	49	56	63	----	----	----	----	----	----	4
9	19	28	37	47	57	66	76	86	----	----	----	----	----	----	13
10	24	36	48	60	73	86	98	110	----	----	----	----	----	----	10
11	----	44	58	74	90	105	120	135	150	----	----	----	----	----	12
12	----	53	72	91	110	130	150	170	185	205	220	----	----	----	27
13	----	62	85	110	130	155	175	200	220	240	260	----	----	----	23
14	----	----	100	125	155	180	205	230	250	275	300	----	----	----	20
15	----	----	115	145	180	210	240	265	290	315	340	----	----	----	19
16	----	----	135	170	205	240	270	300	325	355	385	----	----	----	17
17	----	----	150	190	230	270	305	340	370	400	430	----	----	----	11
18	----	----	170	210	255	300	335	375	405	440	475	----	----	----	11
19	----	----	185	235	280	330	370	410	450	485	525	----	----	----	3
20	----	----	----	----	310	360	405	450	490	530	575	----	----	----	3
21	----	----	----	----	340	390	440	490	535	580	625	----	----	----	2
22	----	----	----	----	----	----	480	535	580	630	675	725	----	----	3
23	----	----	----	----	----	----	520	575	625	680	730	780	----	----	3
24	----	----	----	----	----	----	560	615	670	730	785	840	890	940	1
25	----	----	----	----	----	----	600	660	720	780	840	900	950	1,000	----
26	----	----	----	----	----	----	640	700	770	840	900	960	1,020	1,070	----
27	----	----	----	----	----	----	680	750	820	890	955	1,020	1,080	1,130	----
28	----	----	----	----	----	----	725	800	870	940	1,010	1,080	1,140	1,200	1
29	----	----	----	----	----	----	765	845	920	1,000	1,070	1,130	1,200	1,260	1
30	----	----	----	----	----	----	810	900	970	1,050	1,120	1,190	1,260	1,330	----
Basis (trees)	----	1	11	12	37	54	41	21	7	2	1	----	----	----	187

One eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, less than 1.0 per cent. Average deviation of individual tree volumes from tabular values, 11.9 per cent.

TABLE 59.—*Board-foot volume table (international rule) for second-growth western white pine*

Diameter breast high (inches)	Volume (board feet) by total number of 16-foot logs										Basis (trees)
	1¼	2	3	4	5	6	7	8	9	10	
7	23	35	55	80	100						51
8	25	42	70	97	120						63
9	28	48	82	115	145	180					56
10	30	55	96	135	175	215					46
11	32	62	110	155	200	250					55
12	35	69	125	180	235	290	340				59
13	37	76	140	205	265	330	385				51
14	40	83	160	230	300	370	430	490			46
15	43	91	175	255	335	415	480	550			40
16				285	375	460	540	615	690	765	33
17				315	410	510	600	685	770	850	31
18				345	450	560	660	755	855	950	10
19				380	495	610	725	830	940	1,050	17
20				410	540	665	790	910	1,030	1,150	4
21				445	585	720	855	1,000	1,130	1,260	12
22				480	635	780	930	1,090	1,240	1,380	10
23				520	680	840	1,010	1,180	1,340	1,500	5
24				555	730	905	1,090	1,280	1,450	1,620	3
25				595	780	980	1,170	1,380	1,560	1,750	
26				635	835	1,050	1,260	1,480	1,680	1,880	
27				675	890	1,130	1,350	1,590	1,800	2,020	1
28				715	955	1,210	1,450	1,700	1,920	2,160	1
29				760	1,020	1,290	1,550	1,810	2,040	2,300	
30				805	1,090	1,380	1,650	1,930	2,170	2,440	
31				855	1,170	1,460	1,750	2,040	2,310	2,580	
32				900	1,250	1,550	1,860	2,160	2,440	2,720	
Basis (trees)	25	63	93	106	140	86	63	18			594

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1 foot. Trees scaled in 16-foot log lengths, with 0.25-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.11 per cent. Average deviation of individual tree volumes from tabular values, 8.5 per cent.

Table 60.—*Board-foot volume table (international rule) for second-growth western larch*

Diameter breast high (inches)	Volume (board feet) by total number of 16-foot logs										Basis (trees)
	1¼	2	3	4	5	6	7	8	9	10	
7	20	33	50	73							6
8	21	37	60	84	105						24
9	23	41	70	99	125						22
10	25	46	80	115	145	180	205				11
11	27	51	93	130	170	205	240				32
12	30	57	105	150	195	235	275				22
13	32	64	120	170	220	270	315	365			22
14		70	135	190	250	305	360	415			28
15		77	150	215	280	340	400	465			13
16		85	165	235	310	380	450	520	580	645	17
17		92	180	260	345	425	500	575	645	720	18
18		100	195	285	375	465	550	640	715	800	15
19			210	310	410	510	605	700	790	885	10
20			230	335	445	555	660	760	865	970	14
21				365	485	605	715	830	945	1,060	15
22				395	525	655	775	900	1,020	1,150	11
23				430	565	705	840	980	1,110	1,240	3
24				460	610	760	905	1,060	1,200	1,340	2
25				495	650	820	975	1,140	1,290	1,440	5
26				530	700	880	1,050	1,220	1,380	1,540	5
27				565	750	940	1,120	1,310	1,480	1,640	4
28				605	800	1,010	1,200	1,400	1,570	1,750	1
29				640	850	1,070	1,280	1,480	1,670	1,860	2
30				680	905	1,140	1,360	1,580	1,770	1,980	
31				715	960	1,210	1,440	1,670	1,870	2,090	
32				755	1,020	1,280	1,520	1,760	1,970	2,220	1
Basis (trees)	9	25	31	42	45	54	51	42	4		303

One-eighth-inch saw kerf. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths, with 0.3-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.23 per cent. Average deviation of individual tree volumes from tabular values, 8.6 per cent.

TABLE 61.—*Board-foot volume table (international rule) for second-growth western hemlock*

Diameter breast high (inches)	Volume (board feet) by total number of 16-foot logs								Basis (trees)
	1¼	2	3	4	5	6	7	8	
7	22	38	------	------	------	------	------	------	1
8	24	43	75	------	------	------	------	------	1
9	27	50	87	120	155	------	------	------	3
10	29	56	100	140	185	------	------	------	2
11	32	63	115	165	220	------	------	------	1
12	34	71	130	190	250	320	------	------	2
13	37	79	150	220	290	365	------	------	2
14	40	87	165	250	325	410	485	------	4
15	43	96	185	275	365	460	540	------	6
16	46	105	205	310	405	515	600	705	11
17	49	115	230	340	450	570	670	780	5
18	52	125	250	375	500	625	745	860	5
19	------	135	275	410	550	690	820	950	7
20	------	150	300	450	600	750	900	1, 040	3
21	------	160	325	490	655	820	980	1, 140	6
22	------	170	350	530	710	890	1, 070	1, 240	------
23	------	------	380	575	770	960	1, 150	1, 350	2
24	------	------	410	620	830	1, 040	1, 240	1, 460	1
25	------	------	440	670	890	1, 120	1, 335	1, 570	------
26	------	------	------	715	960	1, 200	1, 435	1, 690	1
27	------	------	------	765	1, 030	1, 290	1, 535	1, 800	------
28	------	------	------	815	1, 100.	1, 380	1, 645	1, 920	------
29	------	------	------	870	1, 170	1, 475	1, 760	2, 050	------
30	------	------	------	925	1, 250	1, 575	1, 885	2, 200	------
Basis (trees)	2	5	6	18	16	13	3	------	63

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3 foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table preparedby alignment chart method, 1927. Aggregate deviation from basic data, 0.11 per cent. Average deviation of individual tree volumes from tabular values, 7.9 per cent.

TABLE 62.—*Board-foot volume table (international rule) second-growth lowland white fir*

Diameter breast high (inches)	Volume (board feet) by total number of 16-foot logs								Basis (trees)
	1¼	2	3	4	5	6	7	8	
7	22	38	62	86	------	------	------	------	3
8	24	43	72	100	130	------	------	------	7
9	26	49	84	120	155	------	------	------	8
10	28	55	98	140	185	------	------	------	10
11	31	62	115	165	215	265	------	------	13
12	34	69	130	190	250	305	------	------	4
13	37	77	150	215	280	350	------	------	6
14	40	85	165	245	320	395	465	------	2
15	------	94	185	275	360	445	525	------	9
16	------	105	205	305	400	495	585	680	4
17	------	115	225	335	440	545	650	750	6
18	------	125	250	365	485	605	720	830	8
19	------	135	270	400	530	660	790	920	7
20	------	145	295	435	580	725	865	1, 000	4
21	------	------	320	475	630	785	940	1, 090	6
22	------	------	345	510	680	850	1, 020	1, 180	5
23	------	------	370	555	735	920	1, 100	1, 280	3
24	------	------	400	595	795	990	1, 185	1, 380	3
25	------	------	430	640	855	1, 070	1, 270	1, 480	2
26	------	------	------	------	915	1, 150	1, 360	1, 580	1
27	------	------	------	------	980	1, 230	1, 450	1, 690	1
28	------	------	------	------	1, 050	1, 310	1, 550	1, 790	------
29	------	------	------	------	1, 120	1, 390	1, 650	1, 900	------
30	------	------	------	------	1, 190	1, 480	1, 750	2, 010	------
Basis (trees)	3	13	18	18	17	21	17	5	112

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected principally on the Coeur d'Alene and Kaniksu National Forests in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3 foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.72 per cent. Average deviation of individual tree volumes from tabular values, 8 per cent.

TABLE 63.—*Board-foot volume table (international rule) for second-growth Douglas fir*

Diameter breast high (inches)	Volume (board feet) by total number of 16-foot logs								Basis (trees)
	1¼	2	3	4	5	6	7	8	
7	19	33	55	75					18
8	20	37	62	89	110				46
9	22	41	71	105	130				30
10	25	45	83	120	155				19
11	28	51	95	140	180	220			37
12	30	58	110	160	205	250			25
13	32	66	120	180	235	285	340	390	23
14	35	73	135	205	265	325	385	440	26
15	37	80	155	230	300	370	435	505	21
16		88	170	250	330	410	485	570	12
17		96	185	275	370	460	540	635	11
18		105	205	305	405	510	600	705	8
19		115	225	330	445	560	665	775	9
20		125	245	360	485	610	725	850	5
21			265	395	530	670	790	930	9
22			285	430	575	725	865	1,020	2
23			310	470	620	785	940	1,100	4
24			330	505	670	850	1,010	1,190	3
25			360	545	725	920	1,090	1,280	1
26			385	585	780	985	1,170	1,370	1
27			415	625	835	1,050	1,260	1,470	
28			445	670	890	1,130	1,340	1,570	
29			475	710	950	1,200	1,430	1,680	
30			510	760	1,010	1,280	1,530	1,790	1
31			540	800	1,080	1,360	1,620	1,900	
32			570	850	1,140	1,450	1,720	2,010	
Basis (trees)	25	65	60	74	72	12	2	1	311

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump height, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance, and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.89 per cent. Average deviation of individual tree volumes from tabular values, 9.7 per cent.

TABLE 64.—*Board-foot volume table (international rule) for second-growth western red cedar*

Diameter breast high (inches)	Volume (board feet) by total number of 16-foot logs						Basis (trees)
	1¼	2	3	4	5	6	
7	21	34	57				3
8	23	39	65				4
9	25	44	75	105			13
10	27	50	86	125			10
11	29	56	98	140	180		12
12	31	62	115	165	210	250	27
13	34	68	130	185	235	285	23
14	36	75	140	205	265	320	20
15	38	82	155	225	295	355	19
16	41	90	175	250	325	395	17
17	43	98	190	275	355	435	11
18	46	105	210	300	390	475	11
19	48	115	225	325	425	520	3
20	51	125	245	350	460	560	3
21		135	265	380	500	610	2
22		145	285	410	535	655	3
23			305	440	575	705	3
24			325	475	615	760	1
25			345	505	655	815	
26			370	540	700	875	
27			395	575	745	935	
28			420	610	790	1,000	1
29			445	645	840	1,070	1
30			475	680	890	1,140	
Basis (trees)	4	23	59	71	27	3	187

One-eighth-inch saw kerf, 1-inch boards. For ¼-inch kerf deduct 9.5 per cent. Block indicates extent of basic data. Data collected throughout the western white pine region in stands from 30 to 160 years of age. Stump heights, 1.5 feet. Trees scaled in 16-foot log lengths with 0.3-foot trimming allowance and additional top section to 5-inch top diameter (inside bark). Table prepared by alignment-chart method, 1927. Aggregate deviation from basic data, 0.17 per cent. Average deviation of individual tree volumes from tabular values, 8.3 per cent.

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APPENDIX

YIELD-TABLE MATERIAL AND TECHNIC

TABULAR BASIS

The field and office methods used in this study were essentially those outlined by a committee of the Society of American Foresters (*2*). The basic data consist of 306 sample plots, collected in a systematic search of a large number of western white pine stands between 20 and 160 years of age. The general distribution of these plots by locality is shown in Figure 1. All plots were located in essentially even-aged, normal stands judged to be producing maximum volume for their particular age-site condition. That normal stocking can be recognized with reasonable accuracy is shown by the fact that three collectors, F. I. Rockwell, A. O. Benson, and the writer, working at widely separated intervals, chose for study stands with densities not greatly dissimilar.[4]

PLOT MEASUREMENTS

Plot boundaries were surveyed with a staff compass and steel tape. Horizontal measure was used throughout. The nature of the stands made it impracticable to obtain strictly rectangular plots, but plots were usually 4-sided and acute angles were avoided. The age of the stand represented by each plot was determined by annual-ring counts on increment cores taken from several dominant and codominant white pines, these counts being adjusted to allow for the time needed for a dominant seedling to grow to the height above ground at which the boring was made. Occasionally an intermediate or suppressed tree was bored to make sure that the stand was essentially even-aged; i. e., that the ages of the youngest and oldest trees did not vary by more than 20 years.

Height over diameter curves were prepared for each species present, except that quite frequently the curves of subordinate species present in minor amounts were used on several plots in the same vicinity. A tally of trees by diameter, species, and crown class and a general plot description completed the field work. The volumes for all plots were computed by means of the second-growth volume tables presented in this bulletin, the plots collected in previous studies being recomputed in this way.

The methods used in 1909–1912 varied somewhat from those just described. Most of these variations were of minor importance; but one omission, the lack of a tally by crown class, necessitated an indirect method of site classification for the older plots. Fortunately, this proved an easy matter, due to the definite relation existing between the average diameter of all white pines and the average diameter of the dominant white pines.[5] As the average diameter of all white pines present was easily computed, the size of the average dominant could be determined in turn from this relation and the corresponding height needed in site classification read from the white pine height curve for the plot. This method of site classification was checked on plots for which the actual average dominant height had been measured. About one-half of the predicted values were within 2 feet and two-thirds within 3 feet of the value derived in the usual manner.

SEEDLING HEIGHT GROWTH

As a knowledge of seedling height growth is essential to accurate age determinations, an analysis was made of the growth of 275 dominant white-pine seedlings scattered over a variety of sites and aspects. These measurements show that on soil of average fertility dominant white pines require about 5 years to reach 1 foot and 11 years to reach 4.5 feet in height. The range of sites sampled in this seedling analysis (site index 55 to 65) does not permit accurate adjustment of these values on the basis of side-index classes, though undoubtedly average rate of

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[4] The stand density of the plots taken by each collector was expressed in basal area and compared with the average basal area of the plots of all collectors combined. F. I. Rockwell's plots averaged 4 per cent higher, A. O. Benson's 6 per cent lower, and the writer's 0.5 per cent higher than the average.

[5] This relation was first suggested in the case of Douglas fir by R. E. McArdle, Pacific Northwest Forest Experiment Station.

growth varies measurably with site conditions. However, this variation is rather immaterial at 1 foot, for on the best site sampled it required 4 years and on the poorest site only 6 years for dominants to reach a 1-foot height. On this basis, age determinations in western white pine stands based on annual-ring counts 1 foot above the average ground level can be converted to total age with reasonable accuracy by adding 5 years on average soils, 4 years on better-than-average soils, and 6 years on poorer-than-average soils.

Adjustment of ring counts taken at breast height can be made only with a decrease in accuracy, as the effect of site differences on seedling growth is more noticeable by the time breast height has been reached. For this reason all age counts are made at 1 foot above ground level, or, if the large size of dominants or some similar reason makes this inconvenient, the ring count is converted to age at the 1-foot level by adding the number of branch whorls or knots between breast height and the 1-foot level. When it was necessary to convert breast-high counts to total age at ground, 11 years were added on average sites, 9 years on better-than-average sites, and 14 years on poorer-than-average sites.

PLOT REJECTION

The usual difficulties of locating and recognizing normal stands in the field, and the consequent need of some flexibility in selection to assure reasonable progress, made it desirable to examine data from all plots in the office for possible abnormalities in stocking. Basal-area and number-of-tree deviations of individual plots from the corresponding average values read from a preliminary table were used as the criteria in this work. Each tabular value was, of course, properly interpolated for age and site. These deviations were expressed as percentages of average or tabular values, and any plot varying by more than 2.5 times the average deviation of all plots (i. e., approximately twice the standard deviation) was tentatively rejected. Because of a definite plus skewness in the frequency distribution of these data—i. e., the occurrence of more plots denser than the average than plots less dense—the plus and minus deviation groups were treated separately to assure a more equitable rejection (*13*). This plus skewness is recognizable in each collector's group alike and is undoubtedly due to the relative ease with which understocked plots are recognized and rejected in the field as compared with overstocked. In plot rejection, therefore, the average plus deviation was used with plots denser than average and the average minus deviation with plots less dense. Plot rejection was not purely mechanical; each plot tentatively discarded was carefully scrutinized before a final decision was made as to retention or rejection. The use of both basal area and number of trees in this work set rather high standards, however, and altogether 35, or 11.4 per cent, of the plots were rejected. Of this total, 52 per cent were rejected on basal area, 34 per cent on number of trees, and 14 per cent because of abnormalities in both criteria. Practically all of the remaining plots were within +34 or −30 per cent by basal area and within +73 or −60 per cent by number of trees.

PLOT DISTRIBUTION

The yield tables are based on the remaining 271 plots. These plots vary in size from about 0.05 acre to 2 acres in area, about 60 per cent being under one-half acre and 85 per cent under 1 acre. Each plot was so chosen as to contain a good sample of trees adequately covering their range and distribution in size. Usually 100 to 300 trees per plot was considered an adequate sample.

Table 65 shows plot distribution by age and site class. Note that while the plots are fairly well distributed by age, they are heavily concentrated in a few site-index groups. As particular stress was laid in this study on the desirability of measuring yields on very good and very poor soils, as well as under average conditions, this concentration strongly indicates that, although the range in site quality throughout the western white pine type is large, some 70 per cent of the land producing pine is in two site-index classes and almost 90 per cent in three such classes. An examination of the tabular yields will show the very large differences in wood-producing capacity between the major site groups.

TABLE 65.—*Distribution of normal plots by age and site class*

Age class (years)	Distribution (number) by site index (feet)								
	20-29 feet	30-39 feet	40-49 feet	50-59 feet	60-69 feet	70-79 feet	80-89 feet	All plots	
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Per cent*
20-29				1	1			2	1
30-39	3	9	10	2	2	2		28	10
40-49		1	3	8	14	7	3	36	13
50-59		1	4	11	16	1	1	34	12
60-69			1	4	4			9	3
70-79			3	8	2			13	5
80-89			7	7	4			18	7
90-99			2	4	8	1		15	6
100-109			2	13	29	4		48	18
110-119		1	3	9	12			25	9
120-129				5	5			10	4
130-139				4	2			6	2
140-149			2	5	7			14	5
150-159				8	5			13	5
Total	3	12	37	89	111	15	4	271	
Percentages	1	4	14	33	41	6	1		100

Table 66 gives the distribution of plots by situation and aspect. The preference of western white pine for moist, protected slopes is indicated in this table, since almost half of the classified plots are located on lower northerly aspects. A preliminary analysis of these data with regard to site conditions fails to show any relationship between site quality, situation, and aspect. This is contrary to the usual assumption that lower slopes, for example, are distinctly better in site quality than the ridges, and north slopes similarly better than south slopes. The yield-study data, while too inadequate to solve this problem, indicate that such assumptions on a region-wide scale are at present unwarranted. It will require a great deal of careful investigation to solve this problem and determine to what extent the more favorable moisture relationships on north aspects are compensated on south slopes by a longer growing season, a longer sunlight day, and higher soil and air temperatures.

TABLE 66.—*Distribution of normal plots by aspect and situation*

Aspect	Situation					All plots	
	Flat	Lower slope	Middle slope	Upper slope and ridge	Unclassified		
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Per cent*
Northwest		10	9	6	3	28	11
North		38	13	22	3	76	28
Northeast		18	10	5	3	36	13
East		10	2	2	6	20	7
Southeast		8	1	6	1	16	6
South		4	4	5		13	5
Southwest		5	1	6	1	13	5
West		13	1	3		17	6
None	32					32	12
Unclassified		1		7	12	20	7
Total	32	107	41	62	29	271	
Per cent	12	39	15	23	11		100

CONSTRUCTION OF YIELD TABLES

Yield-table construction followed the methods outlined by Reineke (*15*). Briefly, in this method the tables are based on a series of average curves showing the trend of average dominant height, total stand basal area, average tree basal area, and cubic-foot volume over age. In this study all plots between 45 and 69 feet in site index were used in drawing these average or graduating curves. The usual series of conventional curves are easily derived from these average curves, as the values of any such curves at any age can be expressed as percentages of the average curve value at that age.

The chief advantage of this method is that the tables are based primarily on a series of strong, well-defined curves. This is particularly true of the alignment-chart method proposed by Reineke, for here only one curve need be fitted for each item instead of a series of curves, one for each site class. This general method also produces a stronger table through a very effective system of interchecking related values. For example, the curves of tree basal area, number of trees, and stand basal area must check one another; i. e., at any age the product of tree basal area and number of trees must equal stand basal area. Furthermore, another check is introduced in the so-called *forest form factor–age* curve. The forest form factor is obtained by dividing the cubic volume by the product of stand basal area and the dominant height used in site classification. This value is used to check the curves for stand basal area, height, and cubic volume, for at any age cubic volume should equal the product of stand basal area, average dominant height, and forest form factor. Finally, the fit of these curves to their basic data was checked by computing the average and aggregate deviations for a number of important values. These deviations are listed in Table 67. The average deviations are based on the deviations of individual plots from tabular values expressed as percentages of tabular value. The great variation of individual plots from the tabular values for stands of the same age and site, particularly in such items as number of trees and board-foot volumes, are shown by the relative size of the average deviations. The aggregate deviation is the difference between the sum of the actual values for all plots and the estimated or tabular values of all plots interpolated for year of age and foot of site index. This difference is expressed as a percentage of the sum of the tabular values. The low aggregate deviations indicate that on the whole the tabular curves are correctly balanced against their basic data. Because of the fundamental simplicity of the methods involved, as well as the careful system of cross checking just described, it is felt that yield tables constructed by the alignment-chart method give the maximum degree of accuracy for the data involved.

TABLE 67.—*Average and aggregate deviations of important yield-table values*

Item	Average deviation	Aggregate deviation
	Per cent	*Per cent*
Basal area	±14.1	−0.04
Number of trees	±27.1	[2]−0.08
Total cubic-foot volume	±17.3	+0.32
Board-foot volume:		
International, trees 7 inches and larger	[1]±22.1	+0.51
Scribner, trees 8 inches and larger	[1]±30.7	+1.33

[1] With 1 very eccentric value omitted.
[2] Based on percentage deviations.

The alignment-chart method also permits the presentation of an entire set of yield tables in extremely condensed form. Figure 12 shows the entire set of 22 yield tables given in this report condensed to a single page. Partial stand values, however, can not be read directly from this chart but must be obtained through converting factors. Instructions for reading this chart are given in Table 68.

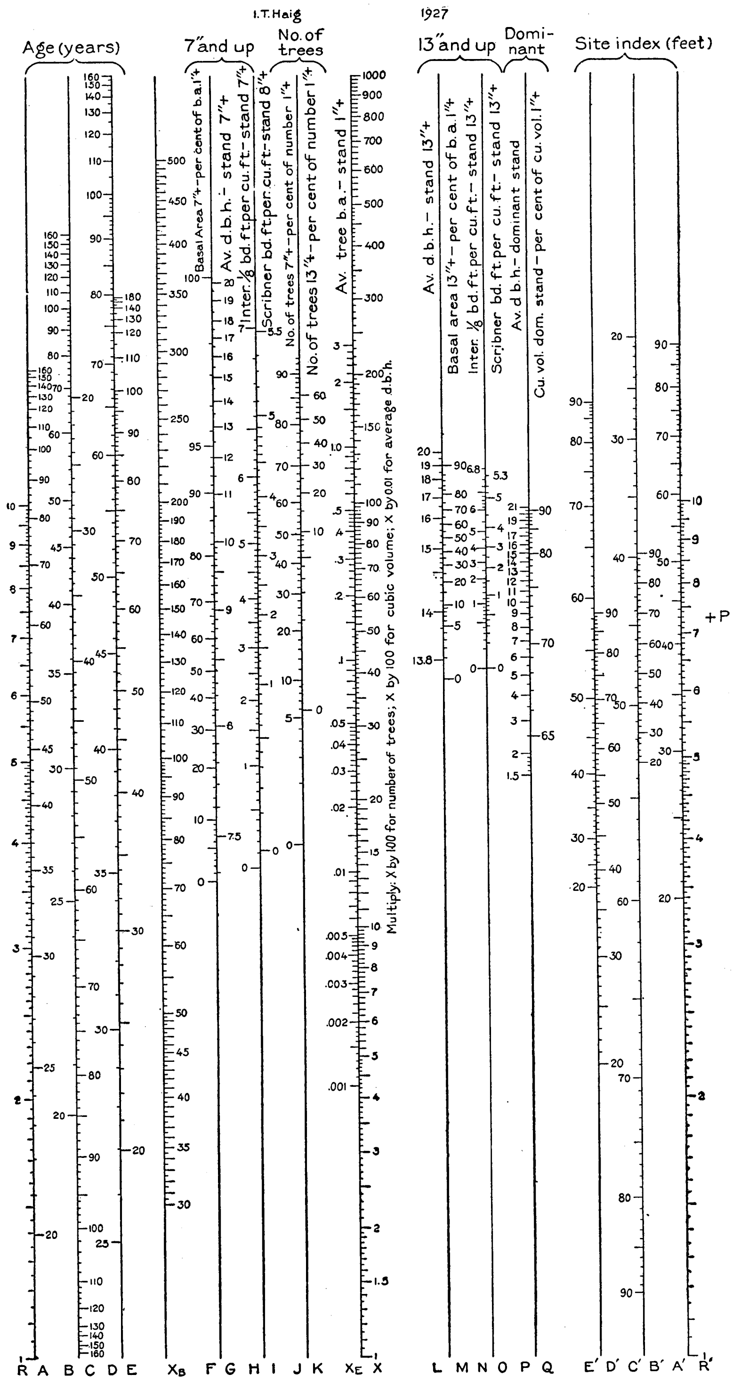

FIGURE 12.—Alignment-chart yield table for second-growth western white pine stands

TABLE 68.—*Instructions for using alignment-chart yield table (fig. 12)*

To obtain—	Hold age on	Hold site index on	Read	Multiply by
A. Site classification, hold age A, hold height of average dominant on X, and read site index on A′.				
B. Height of average dominant white pine	A	A′	X	----------
C. For entire stand:				
1. Number of trees per acre	C	C′	X	100
2. Average diameter breast high (inches)	E	E′	X	0.1
3. Basal area (square feet per acre)	B	B′	X_B	----------
4. Volume per acre (cubic feet)	D	D′	X	100
5. Average tree basal area (square feet)	E	E′	X_E	----------
D. Partial stand: For any of the following items determine similar entire-stand value. Determine average diameter for entire stand. Then pass a straight line through this average diameter on X and point P. Along this line for—				
1. Stand 7 inches and larger—				
Number of trees (per cent)	----------	----------	J	----------
Average diameter (inches)	----------	----------	G	----------
Basal area (per cent)	----------	----------	F	----------
Board feet per cubic foot	----------	----------	H	----------
2. Stand 8 inches and larger—				
Board feet per cubic foot	----------	----------	I	----------
3. Stand 13 inches and larger—				
Number of trees (per cent)	----------	----------	K	----------
Average diameter (inches)	----------	----------	L	----------
Basal area (per cent)	----------	----------	M	----------
Board feet, international (⅛-inch) rule, per cubic foot	----------	----------	N	----------
Board feet, Scribner (decimal C) rule, per cubic foot	----------	----------	O	----------
4. Dominant stand—				
Average diameter (inches)	----------	----------	P	----------
Cubic-foot volume (per cent)	----------	----------	Q	----------
E. To convert percentages and ratios to actual values, hold entire stand or total value on R. Hold percentage or ratio on R′. Read partial stand value on X, pointing off as with a slide rule.				

STATISTICAL ANALYSIS OF RESULTS

STAND COMPOSITION AND YIELD

As has been stated, the western white pine type contains an extremely complex and variable mixture of species. Because it seemed quite possible that certain combinations might be able to utilize the site more fully than others and hence produce higher yields, it was necessary to determine the effect of stand composition on yield. Accordingly, a study was made of the extent to which variations in yield of individual plots from the average or tabular values are associated with variations in stand composition. Modern correlation technic (*4*, *7*) offered the best method of handling this complex problem, furnishing both a numerical measure of the degree of association or correlation between yield and stand composition and a method, if such correlations were found to exist, of predicting the size of such deviations, thus permitting proper adjustment of yield-table values on the basis of stand composition.[6]

From this correlation study it can be stated that stand composition does have a definite though ill-defined effect upon timber yield. While no definite division can be made, it is generally true that, on an average, tracts of pure white pine or stands with large amounts of white fir and, to a lesser extent, Douglas fir tend to overrun the average or tabular volumes, while stands containing large amounts of hemlock and, to a lesser extent, larch and cedar tend to run somewhat lower in volume than the average. These tendencies, however, are weak and relatively ill defined, as indicated by the small size of the correlation indices, which are 0.27 ± 0.06 for the board-foot-stand composition and 0.41 ± 0.05 for the basal area-volume stand composition relationships. (Correlation index is a statistical measure of the degree to which two variables—in this case, yield in either board feet or basal area and stand composition—tend to associate or change together.) As the correlation indices show, the relation between basal-area values, and hence probably cubic-volume yields and stand composition, is somewhat stronger than the relation between board-foot volumes and composition. Nevertheless,

[6] The formula used was: Volume (actual in percentage of tabular volume) = stand composition by basal area (i. e., sum of the percentages of white pine, western larch, Douglas fir, lowland white fir, western hemlock, western red cedar, and miscellaneous).

in neither case is the correlation strong enough to permit the accurate prediction, for any given stand composition, of the corresponding percentage of overrun or underrun from tabular values.

Stand composition is simply one of a number of factors, though one peculiar to mixed stands, causing variation in yield about the average. As over 90 per cent of the total variation is caused by factors other than stand composition, the effect of this factor is largely obscured by other variables and can, for most practical purposes, be ignored. Indeed, in the method of application suggested, calling for a cruise of the stands for which yields are to be predicted, the effect of stand composition on yield, up to the age of the stands sampled, has already made its influence felt and is properly allowed for in the measured basal-area values. The effect of stand composition on future growth, however, can not be predicted accurately on the basis of our present knowledge and, as with deviations in degree of stocking, must be ignored in making future predictions. In general it should be noted that in stands containing large amounts of western white pine, white fir, and to a lesser extent Douglas fir, overstocking as commonly defined in terms of basal-area values may be at least partially due to the effect of stand composition as well as to abnormal density. To this extent such stands may always remain somewhat higher yielding than the average stands. In like manner stands containing large amounts of hemlock, and to a lesser extent larch and cedar, may be somewhat lower yielding than the average, partially or entirely because of the effects of stand composition as well as any lack of adequate numbers of trees or their proper distribution. In this case and to the extent to which this is true, no progress toward normality can be expected and such stands may always remain somewhat lower yielding than the average.

Under the method of application suggested, in which the present relation of actual stand volumes and tabular volumes is held to remain the same at the future age for which yield predictions are desired, stand composition will tend to result in somewhat conservative predictions for all of the higher yielding combinations, such as white pine-white fir mixtures, and will not result in any appreciable error for stands containing large quantities of hemlock or other species forming the less rapidly growing combinations. In some cases, when predictions are made in the suggested manner, stand composition will tend to counterbalance the tendency of stands to grow toward normality and thus tend to result in more accurate predictions, though in understocked stands of desirable composition the converse will be true.

COMPOSITION AND SITE INDEX

Not only do certain species and combinations of species seem to be able to utilize a given site more efficiently than other species or combinations, and hence produce higher yields, but in addition certain species and mixtures of species seem to be, on the whole, higher yielding than others simply because they tend to occupy the better sites. This is illustrated in the case of pure white pine stands, which on an average are found on the better, higher-yielding sites.

As a knowledge of this relation would be of considerable interest and possibly of value, a study was made of the correlation existing between site and stand composition. If stand composition is expressed in terms of individual species, the multiple correlation coefficient of this relation is 0.35 ± 0.05. This coefficient, showing a weak relation between site and stand composition, would undoubtedly be materially higher if curvilinear relations were considered. If stand composition is expressed in percentage of white pine and curvilinear relations are measured, the correlation index is $+0.66 \pm 0.03$, showing a fairly definite tendency for site index to increase with an increase in percentage of white pine. This coefficient, however, must be regarded with some suspicion, as its size largely depends on the presence of plots from one locality, practically all of which are over 80 per cent white pine and on very good quality soils. It is quite possible that the actual degree of relation is somewhat exaggerated. In conclusion, the best that can be said at this time is that certain mixtures do tend to occur on better or poorer soils than the average and hence run higher or lower in yield than the stand of average composition.

APPLICATION METHODS

As has been stated, the application of normal-yield tables to natural stands requires as one preliminary step the determination of the present density of the stand in terms of normal or tabular stocking. Practical considerations necessitate that stocking be measured in terms of some easily obtained value, such as number of trees or basal area, and that this measure be used to represent degree of stocking in terms of more important values, such as cubic and board foot volumes. Because of irregularities in tree distribution, tree size, and composition, a stand of a given degree of normality according to one factor may not be normal to the same degree in terms of some other stand factor; for example, a stand 80 per cent normal by basal area may not be 80 per cent normal in board-foot contents. Accordingly, a study was made of the relation existing between various stand factors as measures of stocking to evaluate their use in application work.

The basic data for these studies consisted of 306 yield plots, only 35 of which were above or below the recognized normal limits in total number of trees and basal area. Normal plots proved usable in this work, though undoubtedly some distortion is caused by the fact that all of these plots had practically complete crown canopies. For each plot the actual value was expressed in percentage of the corresponding tabular value interpolated for year of age and foot of site index. The deviation of actual from tabular value was shown, of course, in the extent to which this percentage varied from 100 per cent, the tabular value. A study was then made, by means of the correlation technic previously mentioned, of the manner in which plot variations from the normal in any one item are associated with variations from normal in some other plot factor. The correlation coefficients and related statistical constants derived from this study are given in Table 69. As previously stated, the correlation coefficient is a statistical constant showing the degree of the relation between two variables. Such coefficients are held to be reliable if more than three times the size of their standard deviation. Some relation may be said to exist, therefore, between each set of items listed in Table 69 except between cubic volume and number of trees.

The size of these coefficients is an indirect measure of the strength of the relation; and the closer these values approach 1.0, the coefficient representing perfect correlation, the stronger the relation involved. Cubic volume, for example, may be considered closely related to stand basal area, and a change in basal area above or below normal will be accompanied on an average by a corresponding change in cubic volume. The correlation coefficients for total board foot volume and number of trees 7 inches in diameter and larger and for board foot volume and number of trees 13 inches in diameter and larger, respectively, are also relatively high. For this reason, stand basal area has been recommended as the most accurate, most easily obtained item to be used as a measure of stand normality when cubic-foot volume predictions are desired. Number of trees above a given merchantable diameter limit is probably the best when board-foot volumes are needed. The latter criterion is a particularly attractive one, as it requires only a count of merchantable trees as compared to a tally by diameter class of the entire stand. The use of number of trees above a certain size is only feasible, however, in stands that have reached merchantable size, and in addition can only be recommended for short-time predictions, for nothing is known of the possible effect on this measure of stand progress toward normality. Consequently, in young stands or for long-time predictions, stand basal area is still recommended as the most reliable gage of stocking even when board-foot predictions are desired. Indeed, when the curvilinear trend is allowed for, the correlation index for this relationship becomes $+0.79\pm0.02$, indicating a very real relation between the normality of the stand by board foot volume and stand basal area. Some further study is necessary, however, before the exact trend of this relation can be accurately defined. Further work, in fact, is desirable with all of the more important relationships, and this work must be done with a series of plots covering a much wider range of stocking.

TABLE 69.—*Correlation coefficients for various important stand factors*

Between normality percentages of—	Correlation coefficient	Standard deviation of correlation coefficient
Cubic volume—total number of trees	+0.10	±0.06
Cubic volume—stand basal area	+.82	±.02
Board foot, international rule, trees 7 inches and larger and—		
Stand basal area	+.28	±.06
Cubic volume	+.43	±.05
Average tree basal area	+.52	±.04
Number of trees, 7 inches and larger	+.70	±.03
Board foot, international rule, trees 13 inches and larger and number of trees 13 inches and larger	+.88	±.02

STAND-TABLE MATERIAL AND TECHNIC

The method of constructing stand tables used in this study will not be outlined in detail here, since this has already been done elsewhere by Bruce and Reineke (*3*). Briefly, this method utilizes the discovery that in all stands of the same average diameter and similar species, regardless of age and site, tree distribution by size follows very definite and recognizable trends. Occasionally the distribution of tree diameters follows the Gaussian curve of normal frequency distribution (*1*) and can be fairly easily described by mathematical means or plotted in straight-line form upon normal-probability paper. More frequently, however, tree distributions are somewhat skewed and fail to conform to this normal curve. This was found true in western white pine stands in which the curves of tree distribution failed to assume straight-line form on any of the common types of probability paper.

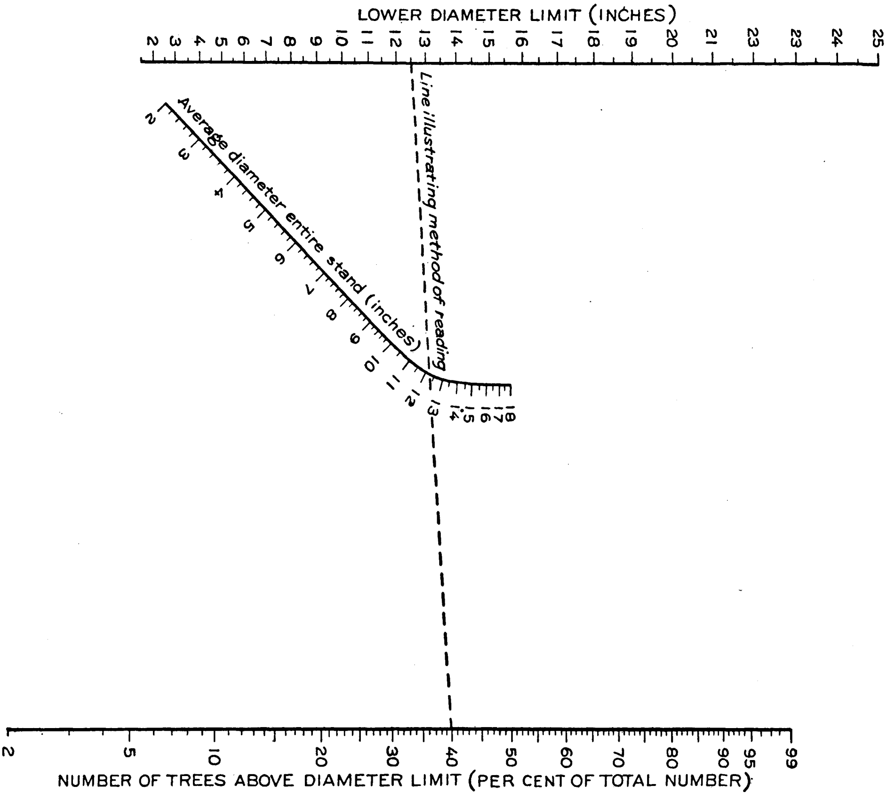

FIGURE 13.—Stand-table chart showing the distribution of trees by diameter class in fully stocked second-growth western white pine stands of average composition

The alignment-chart method devised by Bruce and Reineke is, however, effective in many cases of highly skewed types of distributions. Indeed, this method is so flexible that it proved readily possible to express in alignment-chart form not only the complex tree-diameter distributions for mixed western white pine stands but also the even more complex distributions of stand basal area and cubic-foot volume. Only in the expression of the frequency distribution of volumes in board feet, apparently distorted by the rigid lower diameter limit, did the alignment-chart method prove inadequate. It proved quite possible, however, to express board-foot distributions in a somewhat more complex graphic form.

The basic data in all of this work consisted of the normal-yield plots with complete tree tallies to and including the 1-inch class. These plots were grouped into 1-inch classes according to average diameter of the entire stand, and for each of these groups a curve was prepared showing the accumulative percentage of total number of trees above successive lower diameter limits. This series of curves was in turn reduced to a single composite or graduating curve showing the average accumulative percentage of total number of trees for various lower diameter limits. This curve was then anamorphosed into straight-line form and used in the preparation of an alignment chart (fig. 13), showing for stands of various average diameters the percentage of total number of trees above various lower diameter limits.

To use this chart, pass a straight line through any chosen lower diameter limit on the left-hand scale and the average diameter of the entire stand (based on average tree basal area) on the short-center scale and read the percentage of total number of trees above the chosen diameter limit where this extended straight line crosses the right-hand or percentage scale. If, for example, the stand averages 12.2 inches in diameter at breast height (the average diameter of 120-year-old stands on good sites as shown in the yield tables) and it is desired to know the percentage of trees in and above the 13-inch class, pass a straight line through 12.5, the lower diameter limit of the 13-inch class on the left-hand scale, and 12.2, the average diameter of the entire stand on the center scale, and read 40.0 per cent on the right-hand scale. This reading is illustrated in Figure 13. To convert this percentage reading to actual number of trees, multiply it by the total number of trees in the stand, in this case 390. A series of readings at successive diameter limits, each reading being subtracted in turn from that of the preceding value, will give a series of percentage values of trees in each individual diameter class. These percentages are, of course, easily converted into actual number of trees by multiplying by the total number of trees in the stand.

Similar charts were prepared in the same manner for total stand basal area and total cubic-foot volume. In each case the reliability of these charts has been checked graphically against its basic data and scale adjustments made, until the chart conformed very closely to these data and it was evident that any further improvement would be too slight to warrant the labor involved. The reliability of these charts in practical application as affected by stocking and composition has already been discussed.

VOLUME-TABLE MATERIAL AND TECHNIC

BASIC DATA

The basic data for these tables consist of individual tree measurements collected in second-growth stands throughout the western white pine type by a large number of forest officers. The field methods used in collecting these data were in the main those outlined in the standard methods (*2*). The office computations for western white pine (except the actual preparation of the tables) also conformed quite closely to these standard instructions. But the tree measurements for all other species were plotted on basal-area paper and their volumes computed by the methods described by Reineke (*14*).

METHOD OF CONSTRUCTION

The method of constructing volume tables used in this study has also been outlined elsewhere (*16*). Briefly, it consists in an application of multiple curvilinear correlation principles to volume-table construction. Each volume table is prepared originally in alignment-chart form.[7] The method employed bases the entire table on a few curves fitted to the whole of the basic data. As a result each curve is strongly defined, and the resulting chart gives the best approximation of individual-tree volumes from known heights and diameters that it is possible to make with the material used. In addition, while the technic is somewhat difficult to master at first sight for anyone not mathematically trained, the method is essentially simple. It is very rapid; the basic curves are often straight or approximately straight lines and hence easily fitted with the least possible demand on the judgment of the constructor. The alignment-chart form in which the tables are originally built, illustrated for the white pine cubic-foot volume table in Figure 14, also permits rapid interpolation and checking. To read this chart, pass a straight line between the tree diameter and the total height and read the cubic contents where this line crosses the center scale.

[7] In each case the alignment chart expresses the multiple curvilinear correlation equation: Tree volume = function (tree diameter breast high + tree height).

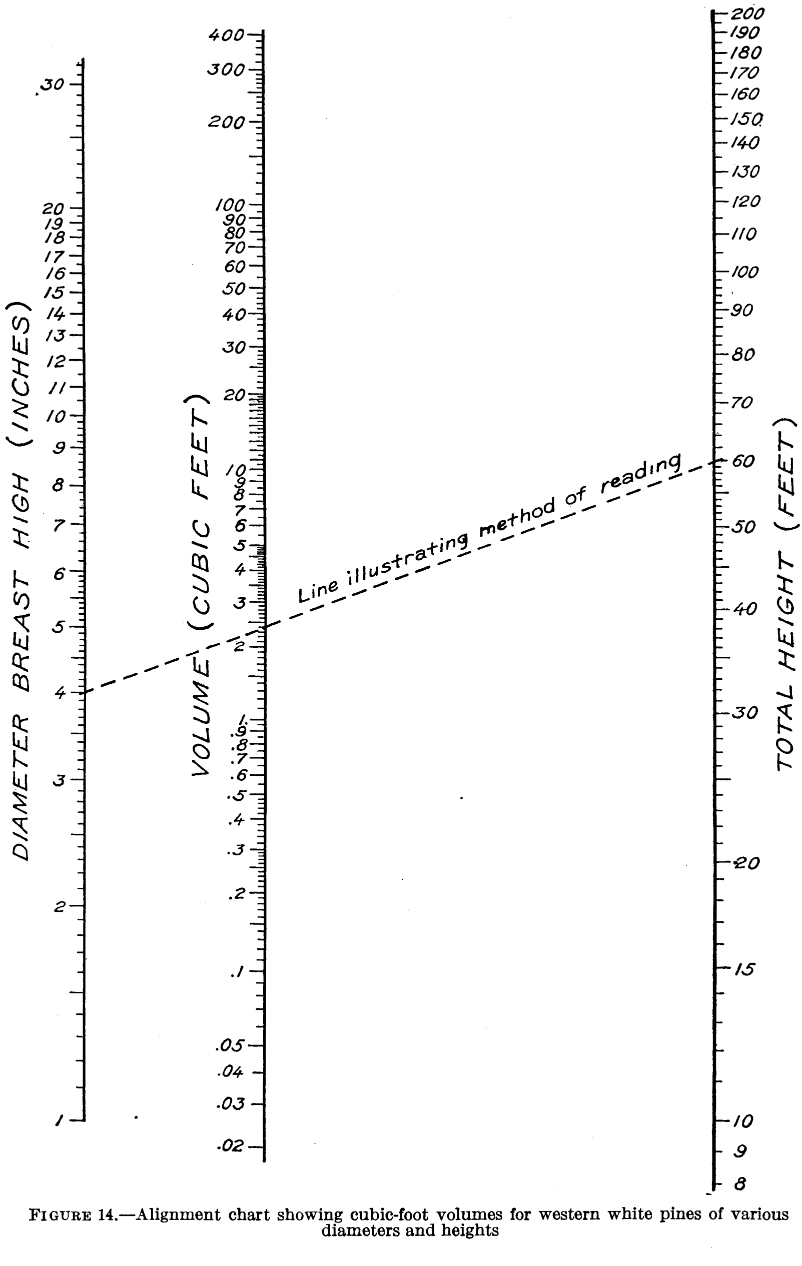

FIGURE 14.—Alignment chart showing cubic-foot volumes for western white pines of various diameters and heights

TABULAR CHECKS

Table 70 shows the aggregate and average deviations for the 30 volume tables presented in this bulletin. The aggregate deviations represent the difference between the sum of the actual volumes of the trees used in preparing the table and the sum of similar volumes read from the table for trees of corresponding diameters and heights. This difference is expressed in percentage of the tabular volumes. These deviations never exceed 1 per cent, and about two-thirds of them are 0.5 per cent or under. These checks are considered very satisfactory. The average deviations are based on the deviations of individual tree volumes from the corresponding tabular volume interpolated to the nearest tenth inch of diameter and foot of height. These deviations are almost all relatively small. The total-height tables, both cubic foot and board foot, were also checked by computing and plotting the board foot–cubic foot ratios and introducing such minor changes in the charts as were necessary to produce reasonable trends in these data when over plotted diameter.

TABLE 70.—*Aggregate and average deviations for second-growth volume tables*

AGGREGATE DEVIATIONS

Species	Type of table				
	Cubic	Scribner		International	
	Total height	Total height	Merchantable height	Total height	Merchantable height
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Western white pine	±0.50	+0.44	−0.13	−0.25	+0.11
Western larch	−.60	+.70	−.25	−.39	+.23
Western hemlock	+.31	−.23	−.06	−.44	+.11
Lowland white fir	+.02	−.18	−.14	−.59	+.72
Douglas fir	−.60	+.70	−1.00	±.50	+.89
Western red cedar	−.05	±1.0	+.35	±1.0	+.17

AVERAGE DEVIATIONS

Species	Cubic total height	Scribner total height	Scribner merchantable height	International total height	International merchantable height
Western white pine	±7.4	±11.6	±8.5	±11.1	±8.5
Western larch	±8.4	±15.7	±8.2	±12.2	±8.6
Western hemlock	±8.2	±11.8	±8.6	±10.3	±7.9
Lowland white fir	±8.0	±15.8	±8.2	±13.6	±8.0
Douglas fir	±9.9	±23.3	±9.8	±15.4	±9.7
Western red cedar	±8.0	±15.6	±6.7	±11.9	±8.3

One interesting point brought out in Table 70 is that the average deviations for total-height tables, both Scribner and international, are materially higher than the average deviations for the corresponding merchantable-height tables. This is probably due to inconsistencies introduced by the variability of top length above the merchantable upper diameter limit, a factor present in total-height but eliminated in merchantable-height tables. Other things being equal, merchantable-height volume tables are, therefore, somewhat more accurate than corresponding total-height tables.

Another peculiarity of total-height tables is that they show seemingly ridiculously low values for trees of small dimensions. The explanation is, of course, that these tables are built to show average merchantable contents. The smaller diameter classes often include trees that do not contain a 16-foot log and are unmerchantable by the standards adopted in this study. The tabular value for these smaller classes, therefore, must be proportionately low, since in applying the total-height tables the tabular value will be multiplied by the total number of trees tallied in each diameter class regardless of whether or not all such trees are merchantable.

TABULAR LIMITATIONS AND APPLICABILITY

Some limitations of these tables should be emphasized. (1) They are directly applicable only to trees growing in second-growth western white pine stands. (2) The tables for lowland white fir and western hemlock are rather weak as to tree basis and the basic data are somewhat localized. These tables should be replaced when additional tree measurements drawn from a wider range of localities become available. Within these limitations, however, except for such minor changes as are found necessary in specific cases of local application, these tables are considered applicable regardless of such factors as site and general locality, and stand composition, density, and age. A thorough mathematical study along multiple correlation lines indicates that these factors do influence tree form and hence tree volume to some extent. But this influence is relatively weak, and the studies indicated that a volume table based on diameter and height alone would be sufficiently accurate for all practical purposes.

To check the applicability of the volume tables in any particular locality: (1) Fell and scale a number of trees of various sizes well distributed over representative areas. Twenty-five or thirty trees should be the minimum number measured for each check. (2) Compare the gross scale of each tree measured with the tabular volume for a tree of the same dimensions, and express the difference between these values as a percentage of tabular value. The sum of these percentage deviations (disregarding sign) divided by the total number of trees measured is termed the average deviation. (3) Compare the total scale for trees measured with the total scale for trees of similar sizes as read from the volume tables. The difference between these sums, expressed as a percentage of the total actual scale, is called the aggregate difference. (4) If the average deviation computed is of about the same magnitude as the average deviation shown in the footnotes of the table, and if the aggregate deviation computed does not exceed two and a half times the computed average deviation divided by the square root of the number of trees measured, then the table may be applied without adjustment. If the variation materially exceeds these limits, however, the volume tables must be adjusted for local use. To make this adjustment, average the percentage relationship between check trees and corresponding tabular values for each inch class represented in the check trees, and plot these values over diameter. Draw a smooth balanced curve through these percentages. If the relationships are not uniform for trees of all height classes, group tall, medium, and short trees separately and prepare a curve for each group. These curve readings will indicate how much to raise or lower tabular values to correct for local conditions, and a table so prepared should be accurate for local use.

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