TREE FORM OF PINUS RADIATA.

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Taper curves were recently constructed from the measurements of 520 trees growing in the Nelson/Marlborough Forest Conservation Region, from which a local volume table was compiled covering eight 10 feet height classes (60-130 feet) and twenty-five one-inch D.B.H. classes (6-30 inches). A study of these data shows certain features in the form of stems of *P. radiata* in this district.

Prof. Jonson (1) has shown that tree form can be indicated, relatively, by an "absolute form quotient" or "form class" which is expressed by $\frac{d}{D}$, where D= D.B.H. inside bark and d= diameter inside bark halfway between B.H. and the tip of the tree. The form quotient is dependent on the size and shape of the crown in relation to the total length of the tree, and varies with age, density of stand and site only so far as these factors influence the crown. On this basis a mathematical formula was devised by Hoejer (2) for calculating as a percentage of D.B.H., the upper diameter of certain conifers in Europe. The tapers of the local *P. radiata* do not fit in with those given by this formula, but they do conform to a strikingly close degree with those given by a more recent formula by Behre (3) which is derived from an equation having the form of an ordinary hyperbola, the values of which are dependent on $\frac{d}{D}$ as in the first formula. To compare the local taper curves with Behre's formula, butt swelling which was prominent even at breast height in all the trees investigated, was eliminated by extending the concave part of the taper curves downward to B.H. and reading off the resultant "normal" D.B.H. inside bark. These values were used as D in the expression $\frac{d}{D}$ to find the form class of each taper curve. Having determined this, the diameters at every tenth of the length above B.H. were calculated by the formula as a percentage of "normal" D.B.H. and compared with actual measurements from the local tapers. An average of the differences, over the whole range of the local tapers, as percentages of "normal" D.B.H., is given below :—

	Tenths of Length above B.H.								
Average of Differences	1	2	3	4	5	6	7	8	9
	+0.7%	+0.9%	+0.6%	+0.2%	—	+0.1%	+0.1%	—0.1%	Nil

+ or — to local tapers.

With the average tree, 17.1 inches "normal" D.B.H. inside bark, the greatest difference in the second column would only be 0.15 inch. in diameter.

The 520 trees used in the construction of the local tapers consist of two definite age classes, 70% being approximately 20 years and 30% 47 years old, and two density of stand classes, namely maringal (including trees grown in single and double rows) and inside trees, that is trees grown in the interior of stands. The method employed (as in the case of all Vol. Tables based on height and D.B.H.) in determining the local tapers was such that the final curves should express the average tree form of the whole 520 trees. A variation in form class of from .600 to .650 between the 60 feet and 130 feet height classes was noted and this is due to the fact that the two age classes only merge to any extent about the 100 feet mark, the young stand being almost exclusively in the 60-90 feet height classes and the old stand in the 100-130 feet classes.

To compare the differences in tree form under the classifications of age and density of stand, approximately 20 trees were taken from each of the following groups, (1) Young marginal trees, (2) Young inside trees, (3) Old marginal trees, (4) Old inside trees. The trees of each group were plotted on cross section paper and a curve, expressing the average taper of each group, obtained. A study of these four average tapers is summarised in the table below, which suggests that trees of old stands have a fuller form of stem, greater bark thickness and more butt swelling than younger trees, and that marginal trees taper more rapidly and have less butt swelling than inside trees.

	Av. Taper	Form Class	Double Bark Thickness as a percentage of D.B.H. Outside Bark	Butt Swelling at B.H. as a Percentage of D.B.H. Inside Bark	Height above ground to which butt swelling extends as a percentage of total Length of tree.
Young Stand	Inside Group	.645	10.8%	5.7%	9.4%
Young Stand	Marg. Group	.587	11.6%	2.8%	8.9%
Old Stand	Inside Group	.728	14.1%	10.9%	35.3%
Old Stand	Marg. Group	.649	13.2%	4.3%	21.4%

Although the above four average tapers were not all of the same D.B.H., the table should give a true comparison because bark thickness and butt swelling in *P. radiata* seem to vary in a constant proportion (within the limits of this investigation), to D.B.H. outside bark and D.B.H. inside bark respectively, other factors being the same. With the exception of the average taper of the inside trees of the old stand, all conformed very closely with measurements given by Behre's formula. The former showed discrepancies up to 4.6% of "normal" D.B.H., particularly towards the top where diameters given by the formula were greater than those of the average taper.

Insufficient date are available here so far to determine the indirect effect of site on stem form.

Conclusions.—It appears that the factors of age and density of stand indirectly affect the stem form of *P. radiata* sufficiently to warrant the adoption of form classes as a basis for discrimination between local volume tables, and that by using Behre's formula, where possible, fewer field measurements and less office work would be necessary in their compilation. In practice, the soundness of the use of form class volume tables would depend on the degree of accuracy with which the timber appraiser could estimate the form classes of stands, a most important factor being the determination of bark thickness and butt swelling by sample trees.

Literature Cited.

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(2) Chapman, H. H. (1924). Forest Mensuration (2nd Edition), New York.

(3) Behre, C. E. (1923). *American Journal of Forestry.* Vol. 21, p. 507.