

other plants which are commonly referred to when describing forest types — the so-called forest-type indicators. There is adequate information, well presented, of life history, including flowering and fruiting, seed production and dispersal, seedling development and growth habits, together with critical or limiting habitat factors.

Growth and yield are itemized and tabulated to a considerable degree, including the variations which can be expected on different sites (site index is shown by height/age relationships for all major species) and under different conditions of competition and forest types. The individual section for each species concludes with a reasonably comprehensive statement about pathogens under the subtitle of "Principal enemies" which, when read with the bibliography, is probably adequate for the generally interested enquirer. Finally, the main contributor for each species is identified.

The reviewer has read through and studied this work in detail. There are many minor points which could be commented on, but in most cases any implied criticism would be unwarranted — the comment being occasioned by surprise rather than disagreement with the facts as written. A few of the photographs add nothing to the text, such as the photograph of white fir crowns on p. 46 captioned as "white fir gradually invading an old brush field in California". The presence of photographs throughout, however, generally adds much interest and value to most sections.

Many foresters and scientists will want to have ready access to this book, which attempts an almost impossible task, and has achieved its objective in a masterly and praiseworthy manner. It is feared that the binding will not withstand the frequent, continued use that will be made of this work.

W. J. WENDELKEN

PRINCIPLES OF FOREST TREE AND CROP VOLUME GROWTH

by H. R. Gray, 1966. Bull. 42, For. & Timber Bureau, Canberra. 54 pp., 7 tables, 29 graphs, 22 references.

This mensuration monograph is based on a further development of the "taper line" theory as presented by the same author in an earlier paper: "The form and taper of forest tree stems" (*Imp. For. Inst. Paper No. 32*, Oxford, 1956). The author points out that the material contained in the present paper is based on theories he has developed and tested from 1936 onwards. The bulletin is divided into four parts:

Part I. The volume line.

Part II. The volume growth of a single tree.

Part III. The "pattern" of volume growth in an unthinned even aged coniferous crop, as exemplified by the volume, at different stages, of the hypothetical 'α' tree falling on an envelope curve to successive volume lines.

Part IV. A hypothesis for principles of forest tree and crop volume growth in general.

After reviewing the work by other investigators and by himself on the "volume line", the author shows how the parameters of this conventional regression of tree volume on tree basal area can be related to those of the equivalent taper-line-based regression,

namely, parabolic volume (volume as defined by the taper line) on parabolic base (sectional area of the taper line when produced to ground level).

On the basis of data available for various stands, it is shown that the latter regression of parabolic volume on parabolic base is strongly linear, and so is the regression of tree basal area (o.b.) on parabolic base, which the author refers to as the "basal area line". From the above it follows that parabolic volume is also linearly related to basal area. Next it is pointed out that, by and large, parabolic volume closely approximates both total stem volume and merchantable volume to a small diameter top (e.g., 4 in. top). This leads the author to submit the above findings as a "rational theory for the volume line".

The author then examines what stand parameters may be used to fix upon the correct slope and position of the volume line. The line cannot be related directly to the top height of the stand, but is found to vary with the parabolic height/total height ratio of the tallest trees, and with the gradient of the basal area line. Accurate determination of these parameters requires full measurement, by the taper line method, of representative trees over the diameter range, and this, of course, allows for the derivation of the volume line in the normal manner without making use of the above-mentioned stand parameters. But the author believes that, following the accurate measurement of a number of stands in this fashion, the required stand parameters may henceforth be approximated for "crops of similar character". The only additional stand information required in that case would be the d.b.h. and height of a number of trees selected to cover the diameter range. This information would then be used to construct the appropriate volume line for that stand.

With respect to the volume growth of a single tree the author submits the basic formula: $V_p = C \cdot s_p^r$, where V_p = parabolic volume, s_p = parabolic base, while C and r are values which vary with the taper of the tree at different stages of its development. However, as there is no means of predicting beforehand how C and r will vary with age, it is hard to see how the author can refer to the above formula as "the parabolic volume : parabolic base growth curve". There is no way of predicting growth with this formula as it stands, nor does it represent a linear regression when written in logarithmic form as claimed by the writer. This would only be so if C and r were constants.

In a similar way, the subject-matter discussed in Parts III and IV is not concerned with the volume growth of a stand as the title would lead one to believe, but with the variation in slope and position of the volume line for parabolic volume on parabolic base at successive measurements in the same stand. The author presents a set of such volume lines for an unthinned *P. radiata* stand based on stem analysis data from 17 trees. The volume lines are drawn at 2-year intervals from 7 to 20 years of age. The author concludes that a linear relationship exists between the intercept and the square of the gradient for such a set of volume lines. This means that the lines must all be tangent to a common curve through the origin, known mathematically as the "envelope of the moving line". Values for parabolic volume and parabolic base at the points of contact can also be derived and the author puts forward a theory

that these values are representative of the smallest trees able to survive in such a stand at each stage of its development.

Unfortunately, much of the bulletin makes confusing reading, and the theories and hypotheses put forward by the author appear to be tested in neither a very convincing nor scientific manner. The worst feature is the apparent ease with which the author interchanges the parameters of the tree volume line with those of its counterpart derived from the taper line — *i.e.*, the regression of parabolic volume on parabolic base. Time and again one comes across the statement that relationships which apply to the latter regression should, by and large, apply to the volume line also. The paper seems too preoccupied with parabolic volume and its relationship to tree or stand parameters derived from the taper line. The statement that parabolic volume closely approximates both to merchantable volume with small top diameter limits and to total stem volume, while in other cases it could be looked upon as a close approximation to the total volume of stem and branch wood combined, is hardly reassuring. It would seem that many more factual data are required to test the relationships, not only for parabolic volume, but more especially for true volume in both thinned and unthinned stands.

J. BEEKHUIS

The *Journal* is the official publication of the N.Z. Institute of Foresters. It is published twice annually. A consolidated index is at present produced for every 600-page set of three volumes. The subscription for non-members is £1 per annum or 10s 0d per copy.

Journal subscriptions and accounts are payable to the Honorary Treasurer (C. H. Brown), N.Z. Institute of Foresters, P.O. Box 511, Rotorua.

Back issues of the Journal may be obtained from the Honorary Librarian (G. C. Weston), c/o Forest Research Institute, Rotorua. Journals up to 1947 are now out of print, but secondhand copies are sometimes available.

Correspondence on editorial matters should be addressed to the Honorary Editor (D. S. Jackson), c/o Forest Research Institute, Rotorua.

Papers and articles for the Journal should be in the hands of the Hon. Editor by 1 January and 1 July for the first and second numbers, respectively, in any particular year. Authors are requested to refer to the *Instructions to Authors* printed on page 82 of this issue.