

method has been tested, and this accomplishes the division into but two groups which, in French forest regulation, is considered sufficient for many-aged forests containing no overmature or decadent timber. The method is to select from the yield table two ages corresponding with the groups to be made.

From the growth curve, the diameter of a tree of this age is found for each group, and from the average height, and volume table, the average volume. A stand table gives the total number of trees, and the total volume.

With the above data determined, there can be but one solution—the number of trees of each average diameter and volume can be found whose sum of volumes gives the total estimate—this gives the volume in each of the two age classes. A thorough check of this method has failed to show any inconsistencies in reasoning, and its application is quite simple. The algebraic solution is as follows:

a = average volume of smaller or younger trees.

b = volume of larger or older trees.

c = total number of trees.

d = total volume.

x = number of younger trees.

y = number of older trees.

Then $ax + by = d$

$a(x + y) = ac$

from which

$(b - a)y = d - ac$

$$y = \frac{d - ac}{b - a}$$

$x = c - y$

33. The two outstanding requirements of growth studies are therefore the separation and standardization of site factors correlated with height and yield tables, and the preparation of these yield tables on a normal or index basis. All other problems can be solved when these are attained.

The question now arises, as to the application of these methods of using yield tables, to obtain average growth data over large areas.

NOTE ON THE MEASUREMENT OF GROWTH FOR LARGE REGIONS

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Fundamental to the determination of growth or volume increment over large areas is a forest classification based on percentage areas.

The regional classification has presumably been settled by the committee appointed for the purpose. In that connection, however, it is worth emphasizing that for purposes of timber assessment like the present the occupational or economic history of the land has often produced more definite uniformities of form, type, and condition than the fundamental factors of topography, climate, and soil. It is possible, for example, to consider a very large part of Central New England as containing even aged second growth forests of certain transition types with definite age limits, resulting from the treatment of the land. Probably a similar grouping could be made of the culled mixed forests of Northern New England. The first step, then, is to block up New England by regional units, based upon some such criteria as indicated above.

Within each regional block means must be devised for ascertaining the following facts:

1. The percentage of total area forested.
2. Within the forested area the percentage areas of each of the fewest possible number of types that must be reckoned with. This problem will doubtless be simplified by the establishment of the fact that, for a given age and site, yield is constant, regardless of species.
3. For each type:
 - (a) The percentage areas of major age groups taken, say, by twenty-year periods.
 - (b) The percentage areas of a minimum number of density classes. Very high limits would suffice, since it has been shown that final volume has comparatively little relation to number of trees per acre, and insufficient stocking tends to correct itself with age.
4. The percentage areas and the broadest possible site classes determined for this purpose on a topography basis. Probably for many regions it would be safe to call everything quality 2, and avoid this classification altogether. Certainly the determination by normal height growth is too complex for the purpose.

In any large scale problem of timber measurement it is the control of the factors of area that is most essential to a reliable result. In this case the data enumerated above make up the necessary control. It is possible that the broadest of the factors, such as the proportion of forest to open land and the type classification, could be secured by airplane photography, especially in settled country where the scale could

be checked by reference to features already mapped, such as roads and streams. The most obvious and practical method, however, is a set of parallel compass and pace traverses. Once the forest classification for the regional unit is settled upon, these could be made by an experienced man with fair rapidity, particularly where U. S. G. S. Map Sheets are available for checks. These traverses should be run across the main drainage of the country, since the belts of settlement and tillage would thus be cut at right angles and given their proportionate representation in total area. By such a method no actual determination of acreage, except that of the sum total of all the townships in the regional unit, would be necessary. Compiled from the traverses, the percentage areas of the several forest classes could easily be worked out and a sound basis secured for the application of index yield tables to the computation of growth.