# SELECTION OF TREES FOR CLIMATIC STUDY

By EDMUND SCHULMAN

Recent developments have shown that the principles of selection of tree-ring specimens for purposes of climatic studies have frequently been misunderstood or neglected, and have thus led to inferences which may easily be in error. Random sampling of trees in a forest will give an approximation to their average growth as influenced by every active agent in the environment. It is often overlooked, however, that when the objective is the study of climate or especially one element of climate such as rainfall, not a random but a highly selected sample is necessary. Extensive remarks on the selection of specimens, particularly v-cuts, have been published by A. E. Douglass (1).

In the western yellow pine and Douglas fir, in drought areas, the recording of rainfall is greatly emphasized in the average individual by habits of the tree in relation to its dry environment. But other species in other more moist regions ordinarily seek conditions for growth which may permit many undesired influences to operate unchecked. Outstanding examples of this latter class are the California coast redwood and the Monterey pine. Hence the selection of individuals in such cases needs greater care than in our drought areas.

The general climatic quality in ring sequences needs to be established as firmly as possible before any definite climate correlations are worth attempting. This is done by making sure that different trees cross-date. First, the favorable tree must possess high circuit and vertical uniformity; that is, relatively small rings must be relatively small almost everywhere in the tree-trunk, large rings must be likewise large, so that annual growth curves derived from radials anywhere in the tree show agreements with each other approaching identity. Second, different trees from the same climatic area must show pronounced agreement in the changes of radial growth. The greater the distance between the trees combined with closer agreement, the more reliable the mean curve for the region will be, as a record to be correlated with climatic elements. Finally, the mean sensitivity, or average change from one ring to the next, should be high. An extensive set of sequences showing high climatic qualities has been published for the Central Pueblo Area (2).

Such comparisons with climate as those just mentioned are only worth making in trees properly selected for this very use. Hence it is most important to know the topographic and individual characters of locations where such trees may be found. Trees likely to yield good climatic records are as follows:

1. Those which grow high on the sides of steep slopes*; underground water supply is thus reduced to a minimum, and the immediate rainfall must be depended upon.
2. Those which grow on a thin soil; a combination of outcropping bedrock, a thin porous soil, and a steep slope might yield the tree record ideally most sensitive to rainfall.
3. Those which avoid highly exposed points; strain and dessication due to wind often introduce much irregularity into growth (3).
4. Those which are not subject to the influence of immediate neighbors; trees which are overtopped, or laterally suppressed from one or

* The author has the California coastal areas particularly in mind in this instance; in Arizona and Colorado certain differences between north and south slopes enter the problem.

more sides are likely to show erratic growth.

5. Those which are mature; young trees in many species grow very rapidly, or under protected conditions, and growth may be to some extent independent of climatic vicissitudes.

6. Those which have not been seriously injured by fire, or subjected to defoliation or other injury by insects or rodents; the latter effect is sometimes difficult to determine by inspection of the outside of the tree, but comparison of ring sequences will readily show the characteristic sets of thin rings (with faint latewood) slowly returning to normal, or rings with regions of badly deformed or crushed tracheids, phenomena which have been found to record defoliation (4, 5).

7. Those which possess cylindrical boles; a highly nonsymmetric crown system may in some species introduce irregularities in growth in different directions from the axis which may not have the same trend at different times, and thus submerge effects due to climatic changes. Strongly and irregularly fluted trees, showing the dominance of one or more roots, may act in the same way; in some species as the coast redwood in which fluting or lobing is characteristic, the lobes diminish in the upper portion of the trunk which may thus yield a usable record where the basal portion does not.

8. Those which do not grow near roads or other works of man likely to have disturbed their normal action.

The preceding applies to sequences of the last 50 to 100 years or so, all that is useable in comparison with recorded meteorologic phenomena. When results of correlations with climate are extrapolated to intervals of many centuries, other transitory effects, such as slow changes in topography or relatively sudden changes in neighbors need to be considered. However, comparison with growth curves of other trees will usually resolve any anomalous interval in any specimen, which may then be allowed for.

In conclusion, we may call attention again to the general condition in collecting ring records for climatic purposes; the greater the number of variables that influence tree growth in any area, the more careful must be the selection of trees in order to isolate the one variable that is sought.

1. A. E. Douglass. Climatic Cycles and Tree Growth, vol. II, chaps. II, III. Carnegie Inst. of Wash., pub. 289, Washington, 1928.
2. A. E. Douglass. Dating Pueblo Bonito and Other Ruins of the Southwest. Nat. Geog. Soc., Pueblo Bonito Series, No. 1, Washington, 1935.
3. F. W. Haasis. Diametral Changes in Tree Trunks. Carnegie Inst. of Wash., pub. 450, Washington, July, 1934.
4. D. T. MacDougal. Studies in Tree Growth by the Dendrographic Method. Carnegie Inst. of Wash., pub. 462, 124-129, Washington, February, 1936.
5. I. W. Bailey, and Anna F. Faull. Structural Variability in the Redwood. Jour. Arnold Arboretum, vol. 15, 233-254, 1934.
I. W. Bailey. The "Spruce Budworm" Biocoenose. Bot. Gaz., vol. 80, 93-101, 1925.

## FURTHER DATA ON FIRST BEAM EXPEDITION SPECIMENS, 1923

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(The data here given were secured by Mr. Peterson from the original specimens. The results were checked against the original dating records of 1928 and later were compared with recent reviews by the undersigned in which the climatic excellence of each specimen was estimated. This classification is here given in the accompanying table called "Quality of the Record" and expressed in the four letters A, B, C, D. Of these A is the highest quality of record and D is usually so poor as to be un-