BETTER TREES THROUGH SYSTEMATIC BREEDING

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Today I would like to tell you briefly about the efforts of forest geneticists to improve the quality of forest trees. What do we mean by quality? Here, the consumer has the first word. The trees we produce are primarily for timber production, and the timber g r o w i n g and wood-using industries give us our guidelines. Nevertheless, many of the characteristics sought by these industries are of interest to geneticists working primarily with shade trees. For example, tolerance of freezing, resistance to drought and disease, g r o w t h rate, stem form,

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crown shape, color, and flower characters — all these are certainly of importance in determining the quality of a shade tree. Therefore I hope that what I have to say about forest-tree improvement will illustrate how the science of genetics may be applied to satisfy your needs. You can see that forest geneticists and geneticists concerned with shade-tree improvement have a lot in common.

When you consumers can give the geneticists a description of your ideal tree, then our job is to determine how to produce such a tree. Ultimately, when we understand the genetic mechanisms governing the characters with which the consumers are concerned, the tree breeder can produce such trees in abundance.

But let me talk more about how the forest geneticists investigates the role of genetics in determining the particular characters under consideration. The first job we must do is to learn something of the genetic variation within the species of tree with which you are concerned. This variation is of three types — that which is due to racial differences within the species ; that which is associated with individual trees; and that which can be induced artifically in a tree.

Next we must learn more about the differences between individual trees in any particular area. You all know that some trees are tall and thin while others are short and squatty. Some have light, thin foliage; others have dark, dense foliage. When the forest geneticist studies individual tree variation, he is concerned with two questions. First how are such characters as branching or color or tree form inherited (the genetic mechanism) ? Second what are the relative roles of heredity and environment in determining the expression of a character (heritability) ? First we must know how to manipulate the genetic mechanisms to produce the desired character. We breed particular individuals together to produce progenies of known parentage, and we analyze these progenies to find the genetic mechanisms controlling the character. Second we must know to what extent the expression of this character is influenced by the environment. We grow progenies of known parentage in uniform environments to find the extent to which the expres-

sion of the character is dependent upon heredity and upon environment.

Finally, geneticists can sometimes produce new variability by manipulating the germ plasm of a tree. Words like "mutants" and "polyploids" may not be strange to your ear, for they are words used to describe the everyday products of crop breeding. Geneticists also can induce such variation by treating seeds or pollen with X-rays, cold or heat shocks, and certain chemicals. At present very little of this artificial work is being done, for we have yet to exploit the tremendous range of variability which nature has provided us in our native forest trees.

We can proceed to combine characters once we know the range of their variability and something of their genetic control. We do this by selecting individuals bearing one or more desirable characters and by crossing these individuals to bring their desirable characters together.

The work at the Forest Service's Institute of Forest Genetics at Placerville, California, illustrates both of these facets of tree improvement. First, we select representatives of desirable species or of desirable geographic strains. This involves considerable field travel and laboratory analysis in studies of distribution and variation in the species. Then we bring our selected germ plasms together by controlled breeding techniques. We control breeding by isolating the female conelets within a pollen-proof bag to prevent their being pollinated by undesirable stray males. When the female flowers are receptive, we dust them with pollen from the selected male parent. Eighteen months later we collect the fertile seeds resulting from this union. In the following year these seeds are planted in our nursery where we study the characteristics of the offspring.

This technique has produced some remarkable hybrids, two of which I would like to mention here. By combining the insect resistance of Coulter pine, a non-commercial timber species, with the excellent timber quality of Jeffrey pine, we have produced a hybrid of acceptable commercial value with seven times the insect resistance of the Jeffrey parent. These hybrids are now being planted in large numbers in California forest plantations. By combining the drought-resistant but slow-growing knobcone pine with the rapid-growing but frost-susceptible

Monterey pine, we have produced a hybrid which is drought resistant, frost resistant, and capable of exceptionally rapid growth, without sacrificing wood quality. At the Institute of Forest Genetics this hybrid has grown more than 30 feet in height in the first 8 years and more than 90 feet at 30 years age.

These hybrids illustrate the improvement that can be made in only a few characters — growth rate, tolerance to climatic extremes, and pest resistance. Other characters, which may pertain more specifically to shade tree quality, can be improved in a similar manner.

Most forest geneticists are not working specifically toward improving shade trees; yet the results of our present research have incidentally provided some potentially valuable shade trees. Work all across the country is being done by forest genetics in the employ of federal, state, and private organizations. They are investigating eastern hardwoods, northern spruce, fir and hemlock, pines, and many other groups of commercial trees.

Actually, there is no limit to the improvement which we can effect in the shade trees of today. The process of tree improvement is a dynamic one resembling, for example, that of today's automobile industry. As Mr. Righter, the director of our Institute of Forest Genetics, says, "Next year nobody will be happy with a 1957 model car." So the improved trees of today will be but the base of improvement for the trees of tomorrow.