QUESTION AND ANSWER PERIOD: "HOW DOES FOREST GENETICS FIT INTO MY JOB?"

Editor's note: During this informal discussion an effort was made to tape-record questions and answers addressed to various individuals. The name of the individual to whom the question was addressed is presented first, followed by the question and the answer.

Zobel: Have you been able to link any of the desirable internal characteristics with easily discernible external characteristics? If not, do you hope to?

"No! So far, we have not been able to tell from looking at a tree what sort of wood the tree contains. Many attempts have been made to do this, and such attempts are continuing. It would be wonderful, and entirely possible, to tie certain wood characters to such things as bud characteristics or needle characteristics. If this is done, it will constitute a major advance in this field."

Zobel: Is there correlation (or possibly linkage) between characteristics, so that when we select (or breed) for favorable juvenile characters (rapid height growth for example) we may also be bringing along unfavorable adult characters (failure to harden off, for example)?

"I cannot absolutely say there is linkage between characteristics since we know of none yet in our southern pines. I'm willing to predict that such will be found, and I hear that the Australians now have some reported for Monterey pine. This possibility can be either great or terrifying--depending on which way the linkage goes. It appears, for example, that the very fastest growing young loblolly pines also tend toward "wolf" types and early maturity--early flowering but also early slowing of growth.

"One of you asked why we do not stress cone production in our selections for seed orchards. The possible disadvantageous linkage is one reason. This is a real danger. Late flushing (bud breaking) may be a desirable characteristic to avoid rust infection in loblolly pine, but are such trees slower growing? Or have different types of wood? Some day we can tell you."

Zobel: What species of pine had the bisexual flowers and where was it growing?

"Those slides shown you were of longleaf pine, for trees growing on the lands of A. J. Hodges Industries at Many, Louisiana. *Mr.* Thomas Campbell had observed such flowering for several years in a group of several trees growing close together. We have also found this in loblolly pine. By the way, the longleaf trees went ahead to produce what looked like a normal cone."

Zabel: Should not the geneticist or the forest physiologist tell the pulp and paper people the tree characteristics which will in the end produce the best product for a particular use, rather than wait for them to tell you what they want?

"The geneticist, almost without exception, knows a lot about the tree, its growth and possibly its wood, but very little about paper technology. Thus, he can tell the pulp people that loblolly pine, for example, has certain wood property variations and that we feel we can do certain things with these from a genetic standpoint. But the industry people must tell us whether they need, or can use, these variations. For example, it appears to be very feasible to increase tracheid length in loblolly by selective breeding. Do the industries want longer fibers? What effects will longer fibers have on each particular company's product? This they must tell us. Five years ago there was little interest in fiber length in loblolly pine; what we had was sufficient, industry said. Now, with more hardwoods with short fibers being used and with a better understanding of the effects of fiber length, there is considerable interest."

Zobel: Do you consider the physiology of a tree as important as genetics in some of the phenotypic expressions you have observed?

"This question cannot really be answered as asked since the two, physiology and genetics, cannot be separated. The 'expediting mechanism' of genetics must, of course, be through physiology. The tree we see is the resultant of the interaction between environment and genetics. Both operate, or cause their effects, through the medium of physiology. Each plant has for each character a set of 'genetic limits' beyond which the tree cannot go and survive. Some of these are rigid and narrow, some broad. But actions that take place when environment works on a plant are usually through physiological means which change the plant. But these changes are not heritable--it is only the genetic characteristics (whether they be morphological, physiological, anatomical, etc.) that are heritable as such. This is a complex situation and time does not allow a full discussion, but just remember--every characteristic that we see is the result of an interaction between genetic and non-genetic factors, controlled usually through the medium of physiological reaction."

Zobel: What would be your estimate of the following project?

1. 10-year seed-orchard program.
2. Acreage – 10 acres.
3. Species – loblolly pine
   (a) 5 acres high sp. gray.
   (b) 5 " low "
4. Lower Piedmont – S. Carolina.

"I know the man who asked this question, and he should answer it. Earl, what is the answer?

"Actually, each company keeps its own books and accounts, so I cannot answer such a question. It is, however, a fine question to illustrate what I talked about earlier. Genetics in forestry is an expensive business.

I warn you not to get involved in it unless you do it right; and to do it right costs. Actually, we all feel the costs will be repaid many times over or we would not be in this business. But even if seed orchard establishment is expensive, if we can bring about even a 1% or 2% improvement, the rewards are great. Our companies plant now about 150,000,000 trees each year. If these came from seed orchards with only modest improvement (actually I expect better than 1% or 2%, all told), the returns are staggering compared to the costs of orchard establishment and management, however high. Even if no genetic improvement were obtained, I feel the increased efficiency of cone production, the more regular crops of higher quality seeds would in themselves alone pay for the seed orchard."

Zobel: Does the form of a tree of good species always indicate superior or inferior genetic strain of seed produced?

"No! This was the main theme of my talk--that the form of a tree is dependent upon two things, namely, an interaction of genetic and environmental controls. Thus: phenotype = genotype X environment. Although one cannot always tell superiority from the phenotype, if any genetic control is present, then selecting the better phenotypes will on the average result in a selection for the better genotypes, though the gain may be small or large, depending on the genetic control of the particular characteristic."

Zobel: Can you tell me when is the proper time to release, thin, etc. for natural production of shortleaf pine cones from selected trees that show promise of superior characteristics?

"Flower primordia are produced in late summer or early fall. These "flowers" will become visible the following spring. Thus, the release or fertilization after the primordia are formed will not have any effect until the second spring. For loblolly, we recomment using fertilizers or releasing for flower crops no later than June, prior to the spring you want heavier flowering. Usually the increase will be greater the second rather than the first year after release."

Schreiner: Would you care to comment on Inman's recent polemic in the Journal of Forestry in which he stressed that forest "geneticists" do not avail themselves sufficiently of published material in related fields? (Westing)

"Unfortunately there is considerable truth in Inman's polemic, but there is little justification for the manner in which he expressed his criticism. A blanket indictment of forest geneticists is hardly warranted - there are quite a few of us who do avail ourselves of published material in related fields of genetics and other disciplines. But we must also consider the tremendous amount of material being published today in the broad field of genetics. I believe that those forest geneticists who have had graduate training in genetics do try their utmost to keep abreast of the genetics literature.

"With reference to Inman's attitude, as indicated in his critical note, I would like to suggest that as the old lady said of the postcard, 'there is much to be said on both sides.' In my opinion geneticists working with forest trees should also keep abreast of related forestry

research literature, particularly research in silvics and silviculture. Granted, it is hardly necessary for a geneticist who wishes to carry on cytological research with forest trees to understand the tree improvement objectives and the problems of application of genetics research for the production of better forest stands. This would also apply to the geneticist who wishes to hybridize trees and then simply watch them grow. And the man who is only assigned to the job of carrying on a breeding program with selected trees need not be versed in the art of selecting superior phenotypes, provided he had someone with silvicultural training available to make his selections for him.

"But if the so-called 'forest geneticist' is to direct research or the application of research to the development of improved forests, then in my opinion he can do the best job if he has had grounding in forestry as well as in genetics and keeps abreast of both fields.

"I agree that certainly forest geneticists should be aware of work going on in the related fields and should attempt to keep abreast of the genetics literature - I have found from experience that to do this in the little time available in an 8-hour 'research' day in the office or the field, supplemented by 4 or 5 hours reading at home, has become a rather difficult problem. It was very much easier 35 years ago when I started my forest tree breeding work."

Fowells: Has any of the work in genetics been directed toward rooting habits of genetically superior trees? Our work is in watershed management research. While we desire the optimum amount of good wood from watershed cover, we also wish to improve the permeability or hydraulic conductivity of the watershed soils. Trees having heavy, deep root systems would tend to give us deeper percolation of infiltrated water.

"I know of no research directed at the rooting habits of genetically superior trees, but rooting habit is of interest, particularly as a factor in survival. For example, the hybrid of ponderosa pine and Apache pine has a very fast growing taproot, which may be of importance for planting in dry sites of the southwest."

Fowells: What are the genetic implications of the nursery practice of culling small seedings?

"There is ample evidence to show that early performance of trees is related to seedling size. For example, large seedlings tend to outgrow small seedlings. But although large seed produces large seedlings, there is no relationship after the first few years between seed size and size of tree. One reason to grade seed is to even out the competition in the nursery between seedlings from different sizes of seed. Planting stock graded on the basis of size may not give a superior plantation because of some other factor associated with size but not recognized, as lack of resistance to pests."

Polk: Exactly where in Pennsylvania was this superior jack pine plan-
——— tation located?

"We are unable to give you the exact location. Our information on this plantation was obtained through an article in Pennsylvania Forests and Waters, the July-August, 1951 issue. This article relates that state's initial efforts are toward a production of inherently better and more suitable nursery stock. From a jack pine plantation therein reported as being 'outstanding among superior stands', cones for seed extraction were supplied us by the Pennsylvania Department of Forests and Waters."