REPORTS FROM THE FLOOR
ON WORK IN PROGRESS AND PLANNED IN THE NORTHEAST

LARCH AND THE PROBLEMS OF FOREST TREE IMPROVEMENT

David B. Cook

The larches are an interesting group of deciduous conifers characteristic of northern latitudes or mountainous country. They are fully hardy in the most rigorous of continental climates, grow best on well-watered but well-drained soils of at least moderate fertility. In the Northeast, they can be successfully established on open areas or on cutover land, provided they be kept weeded until they have achieved dominance.

Besides the ordinary uses for sawtimber and piling, larch can be used for kraft and for sulphite pulp, for which it has characteristics like and in some respects superior to spruce. This means early and close utilization and a price at the top of the $$ totem pole. With the better races now available, volume production is very high. This, coupled with high value, should amply justify an aggressive program of tree improvement.

Because of the wide and scattered pattern of distribution of most of the species, the geographic origin of larch is critically important. The races of European larch (Larix decidua) appear to be genetically distinct; Jap larch (L. leptolepis) is much more homogeneous. Two other species of wide geographis distribution are available. The continental Asiatic L. gmelini and our own L. laricina.

Genetically, the larches offer great promise. Cones mature in one year and seedlings may bear good seed by their tenth year. Both inter® and intra specific crosses appear to be possible and most of those made so far exhibit hybrid vigor.

Rapid height growth and volume increment, ability to do well on rough land without site preparation, and high wood value, combine to make the larches a fertile field for genetic improvement. When we can gross 1.5 cords per acre per year of top-value stumpage on ordinary forest land, efforts to develop even better strains through tree improvement make good economic sense.

At Cooxrox Forest, we specialize in larch. Our situation on the Rensse -laer Grit Plateau three miles northwest of Stephentown, New York, provides suitable soil and adequate moisture, so that our phenotypes approach the genotype more closely than is the case with arboretums less favorably situated for larch. After twenty years of planting, the collection has at least a fair representation of those species that will thrive in our climate. These are growing as small forest stands rather than as isolated specimen trees. Many of them are old enough to bear cones.

Larix decidua of the races from Silesia, Scotland, Austria--
and unknown--as well as the locally developed Cranston strain
from Stephentown.

Larix leptolepis; several lots but without much data on specific
origin, other than that they come "from Japan."

Larix gmelini, of seed shipped from Harbin, Manchuria.

Larix eurolepis, the Dunkeld Hybrid, three lots, all labeled as F3.

We also have in the nursery and scheduled for planting in 1954 and 1955, three lots of F1 Dunkeld hybrid, two of the Cranston strain of European and three trees of "Larix olgensis" from Seoul, Korea. Seed on hand, to be sown in the spring of 1954, include one lot of the southeast European strain, "Larix polonica" and one of homegrown F2 Dunkeld hybrid.

Anyone interested in studying the genetic differences represented by this material or securing material for breeding will be welcome to use our forest.

ON THE MASSEY, ONTARIO, SEED SOURCE FOR RED PINE

E. J. Eliason

The subject of the December 1949 meeting of the New York Section of the Society of American Foresters was "Red Pine in New York State." A brochure of the papers of this meeting was published by the New York Section. On the subject of red pine sources, my part of a paper gives the following quotation.

"The Conservation Department has been interested in the seed source of all species used in reforestation; red pine has been no exception. However, it has not been demonstrated in such native species as red pine, just how much difference the seed source makes. So that, for the procurement of seed, no recommendations have been made on source. However, records on the source, insofar as available, have been noted in the overall operation, and a system of seed lot numbers was recommended and established, starting with the seed sown in 1931. In order to determine the possible effect of source, special collections have been made from various parts of the red pine natural range. These include several stations in Ontario and various locations within New York State, representing different elevations, ages of trees, and small islands of trees such as found in the southern part of the State. The first of such plantations were established on Schoharie Experimental Area #20 in 1935.

"The results of these tests are as yet incomplete and observational. For the purpose of thie paper E. W. Littlefield and I visited the Schoharie Area #20 and the Saratoga Area #1 this past fall, where blocks are planted with red pine from different sources. Littlefield in 1941 had noted that the Massey source in Ontario was outstanding in its darker green foliage. The present observations confirm those of 1941. In every location where the Massey source was planted there was a distinction between it and several other Ontario sources. It appeared different also from any of the sources from the Lake States and the Adirondacks. The foliage generally had deeper green color, the needles were longer, and the previous years needles stood out more nearly perpendicular to the stem. As compared especially with other Ontario sources, this source appeared to have made better growth. Plantations from this Massey source from 3 collection years, (1929, 1930 and 1932) all show the same characteristics.

"In case this source proves superior, it is fortunate that the tree distribution of this lot is a matter of record and large plantations can be found from which seed could be collected. Some 800 lbs. of seed were received from the 1930 Massey collection. This seed being one year younger when received in 1932, was held back, while the 1929 collections from other Ontario sources were sown in the fall of 1932. Due to the "depression", no red pine seed was

sown. Records show that some 7 million trees from seed of Massey source were shipped from the nurseries in the fall of 1935 and the spring of 1936 as 2-0 seedlings to state reforestation areas. This is part of seed lot #15. These seedlings germinated in the spring of 1934. The distribution by districts and areas has been tabulated. Some 300 pounds more of the 1932 Massey collection were received in 1934 and sown in the spring of 1935.

"The Massey collecting area, according to R. S. Carman of the Ontario Department of Lands and Forests, extends from Sunbury westerly to Thessalon and includes the islands in the North Channel, just south of the village of Massey. This is a narrow strip, for the roads do not extend to the north. The location from this side of the border is directly north of Lake Huron. The elevation at Massey is 639 feet."

The first plantation collection of Massey red pine was made in District No. 1 in the fall of 1951, with a yield of 2 1/4 pounds. Part of this seed was sown in eight 4 x 12 seedbeds in the spring of 1953. It is expected to collect more as cone crops on trees from this source become available. Also to develop several seed orchards in these plantations.

MAPLE RESEARCH AT THE VERMONT AGRICULTURAL EXPERIMENT STATION

Fred H. Taylor

I feel like pretty much of an outsider in speaking to a group of people who are primarily interested in trees from the timber standpoint. But, I thought you might be interested in a type of selection work which deals with a hardwood tree from a little different angle than that of the woody tissue involved.

For the past 10 maple seasons the Botany Department of the Vermont Agricultural Experiment Station has been investigating variation in the sugar maple. We have attempted to study this variation from four different but related angles. The first has to do with variation in sugar content of sap. In other words, how sweet is the sap or, conversely, how dilute is the sap from tree to tree? The second approach to variation is in yield of sap or volume of sap produced by individual trees. The third is something we have called flow characters for want of a better name. It is sort of a nebulous thing to describe but, in a word, it involves rate of sap flow and influence of temperature on rate of flow in various trees. And finally, there is vigor which has been talked about here in terms of rapid growth. Our goal is to combine in a single clone better than average sweetness, high yield, good flow characters and a tree which would reach tapping size quickly--not one for which we will have to wait 40 or 50 years.

Although we have spent much time on variation in yield and differences in flow pattern, our work on sugar content is closest to the point at which generalizations can be made. In our studies on large numbers of maples we have found that there is a wide range of variability in sugar content of sap among the trees which grow naturally on our northeastern hillsides. We have identified individuals which are much sweeter (if I may be permitted to use that term) than their neighbors and found that this sweetness persists throughout a given season. Not only is this superiority evident in one seasonbut it also

carries over from year to year. Relatively speaking, the tree which is sweet this year is the same one with high sugar content next year--a significant fact with bearing on selection of superior individuals for propagation by vegetative methods.

TREE BREEDING AT THE OHIO AGRICULTURAL EXPERIMENT STATION

Howard B. Kriebel

We are now starting a program of tree breeding at the Ohio Agricultural Experiment Station. Although we are not in the Northeast our problems are so similar that I think there is good justification for our working very closely with people in this region and we certainly welcome any suggestions. We plan to do some selection and hybridization and to start assembling a file of superior trees in Chic and other places. We would gladly make this available to others who are interested in selection work. There has been a lot of talk here about breeding sugar maple for sweetness of sap. We are going to work along that line and try to coordinate our work with that being done in Vermont and elsewhere. One of the first things we are going to do with sugar maples is to set up a racial study to get an idea just how much variation there is in the sugar maple complex so we will have some kind of a basis for systematic selection and intraspecific hybridization.

I will mention very briefly the weevil resistance work. Last spring Professor David Smith and I set out a small experimental plot in which we segregated seedlings on the basis of ratio of bark thickness to the length of the terminal shoot. It is a randomized plantation which we hope will survive and will give some initial information on the value of bark thickness in white pine weevil resistance.

TREE AND SHRUB SEED LAW IN NEW YORK STATE

C. E. Heit

I've been discussing seed laws with Dr. Baldwin inasmuch as several years ago I knew he was particularly interested in such controls. He suggested that I might call your attention to the tree and shrub seed law in New York State. I came down here with the idea of trying to get something out of this meeting and to learn what this conference would like to do in seed improvement.

The Division of Seed Investigations of the Geneva Agricultural Experiment Station handles problems connected with testing of all types of agricultural, vegetable, flower, tree and shrub seed. At the present time we are in the process of revising the New York State Seed Law and I wanted to get ideas from some of you men, how you feel about the law as it is written, your comments or suggestions. I've talked to a few men here who didn't even know that we had a tree and shrub seed law in New York State. I think it is a shame that foresters in general and people interested in seed research and tree improvement do not know that there are such laws in existence and, as Dr. Baldwin said, it's a shame that something isn't done about it on a wider scale.

The present law in New York State requires the following information: (1) The kind of seed and the variety; (2) the approximate percentage by weight of pure seed; (3) the approximate percentage of germination; (L) the year of collection; (5) the specific locality, (State and County, in the United States, or nearest equivalent political unit in the case of foreign countries) in which the seed was collected; (6) the name and address of the vendor of such seeds. Those are the requirements on tree and shrub seed as it stands MN. I might add (Ed. Littlefield, I think, will agree with this) that the Conservation Department and the nurserymen throughout the State have not taken advantage of this law for their protection as they could have done. It has been brought up here several times in connection with the research work that administration bogs down so to speak. These officials or executives of nurseries select and buy the seed and they disregard anything which they might use as a leverage to secure good seed of known source with high germination and purity percent. If any of you are interested in such a law I would be glad to discuss it with you and welcome any comments or suggestions you might have to offer to improve it.

DISCUSSION

IMPROVEMENT THROUGH SELECTION OF WELD TYPES

Eliason I would like to discuss some practical aspects of the use of improved tree stocks. On the matter of stock supply, such as seed, cuttings and propagated trees, the number at first will be very limited. How best can we use them? There are at least two possibilities: (1) They can go into so-called tree orchards where the main purpose is greater number production; (2) they can be planted in such a way as to get the greatest benefit in the plantation itself.

The specification of seed orchards may well be discussed. Mr. McKusick , in "Tree Planting Notes" U. S. Forest Service, Nov. 1951, has written on the subject as related to the start made in Connecticut with a white spruce plantation. A seed orchard should have the primary function of producing the largest quantity and quality of seed. The thinking on such a set-up is quite dif ferent from an ordinary plantation. Its use, is just as the name orchard im plies, fruit production. As an orchard the trees may be pruned in the top permitting low spreading forms which are more easily accessible for cone collecting. The seed orchard may originate from natural seeding, an existing plantation or an intended planting. Each requires a different plan of operation in order to establish an orchard.

Without going into further detail, it seems that an orchard .should be: (1)A desirable seed source worthy of making collections for a seed supply, (2)located at such a distance from other trees as to prevent cross-pollination, (3) spaced to permit the trees full development for seed production (Mr. McKusick suggests 30 feet for white spruce and the spread on open grown pines would indicate at least this spacing), (4) accessible for cone collection, (5) top pruned to permit a low tree form that is more easily reached from the ground or trucks.

One method of establishing a plantation is to plant only elite trees with very wide spacing. Cr we could use narrower spacings and plant with the elite stock some other species, or slower growing strains of the same species, which

will act as fillers or as trainers in the early life of the plantation. These fillers can be removed by artificial means or better, by natural competition, leaving the elite rapid growing strain. The fillers can be planted in one or more rows alternating with single rows of the choice stock. Another method. which may be of interest is the idea of mixing the seed in the nursery before sowing. For example, 20 to 25 percent only of the elite seed could be mixed with the remaining seed of a slow growing variety, of the same or another species. The seed being completely mixed would produce seedbeds with fully mixed trees. These trees planted as they come, would be distributed in the planta tion in a variable pattern. To illustrate a sample pattern, a cup was pre pared containing 25% red colored beans. The beans were withdraw at random and "planted" in rows as they came, up one row and down another until the whole area was covered. The red spots represented an elite strain of one species while the clear spots represented filler trees. It is obvious that every such planting would produce a different pattern an the whole. However, it is the small local patterns Which are of importance. There is crowding of the elite trees in very few instances so that competition would not be severe among them. Most elite trees fall in rows or scattered singly, so that they would have ample room to develop. In the larger areas with only filler tress, it is expected that some of these will become dominant, and thus from some crop trees from the filler species.

There are other points of interest related to the handling of special stocks. One is the handling of seed lets of known origin in the seeding, nursery and planting operations. In the first place it is next to impossible to carry through without mixing, a large number of seed lots of a given species in any kind of a regular nursery operation. When there is any great number, these should be sown and treated as an experimental set-up, with special attention and with trained or at least very much interested personnel to handle them. Much valuable effort can readily be lost by an improper set-up. In placing source lots into a regular operation, the numbers should be reduced to genuine source differences. If possible, they should be separated by years of sowing, by different nurseries, by separate nursery blocks, and with all this a marking system, such as numbers, which will be carried along with the stock and records in all the complete handling. I have noted numerous cases in seeding and nursery operations where the seed procurement people were careful in getting their seed from the right place, but seed was subsequently farmed out to the nurserymen who may or may not have sown them separately, and later in shipping made no provision for keeping the lots separate. In New York State, since 1935, we have assigned each seed lot a number. The highest number now is 387. This number is used all the way through. It occurs first when the seed is extracted or received in a purchase. It is on the storage record, the seed sowing records, on the seedbeds themselves, the crates when transferred to the sheds for packing, on the packing shed records, on the trees shipped to the field and eventually on the permanent record whichis the original order blank. In the State planting the number occurs on the planting record card. Any system will break down if too many lots are attempted. The maximum number should be about 3 or 4 for a single species for a season at, one nursery. Fart of our numbers are collection numbers which allow records up to sowing time. If these numbers are not genuine ones, they are combined and given one single number for sowing. All information about each seed lot num-

ber is kept on file. This is kept on a form called the "Seed Lot Record" which gives all that can be found about the seed itself. It also serves as an index to the seed tests, to the sowing records, and to the disposition of the trees to the field.

The above discussion: (1) Points out the need for planning on the use of the improved trees stocks, especially the need for production in numbers, (2) discusses a seed orchard set-up which will be the primary method of increasing the seed of the improved stock, (3) suggests planting plans to make maximum use of these elite trees in the plantation itself, especially an idea whic h starts with mixed seed. In the mixed-seed method a plantation is produced which gives the elite trees an opportunity for full development, (4) indicates the need for a method of keeping the seed source lots separate in the seeding, nursery and planting operations. It suggests a number method which has been in operation for a number of years in New York.

Kriebel One thing came to my mind during this discussion on selection of forest trees. The agriculturists have quite a different problem that tree breeders in that they are interested in selection for 100 percent pure strains. We are not necessarily interested in that. The agricultural breeders are concerned by the fact that they are eliminating a lot of their wild types, thereby reducing their storehouse of variation or germplasm. don't think we have to worry for quite a while about getting to that stage. Nevertheless, I think it should be mentioned that a lot of these so-called cull stands of poor trees which we are trying hard to eliminate may contain genes that we don't know about at the present time, for example, for resistance to disease. We want to retain some of this material for possible future use.

Ehrhart Gentlemen, I want to say first that I am just a pulpwood forester and some of the terminology you are using here today is way over my head. But the thing that I want to try to get across to you very briefly is this: Although we are just practicing pulpwood forestry, we are also tr ying to look ahead and make practical application of some of the same things you have been talking about. For instance, back in 1940 we conducted an experiment in our pulpwood cuttings from even-aged second growth stands of northern hardwood (beech, birch, maple and cherry) in northwestern Pennsylvania. The particular experiment that I speak of was labeled a "crop tree" plot. We picked out a certain number of trees per acre based on uniform spacing, desirable species, desirable form, not necessarily of dominant position in the forest, but such that gave promise of carrying through to maturity. The objective was to have about 20 trees per acre designated to remain through several cut= ting cycles for pulpwood, so that they would provide the final crop trees of the present even-aged stand. The thought behind it was this: In the problem of providing X number of cords for usage by a pulp mill, we have to provide enough timber to give a margin of safety against possible losses. So, in determining the acreage we require, we say we want a little excess for elbow room. If we don't lose that margin it becomes a surplus, which we want to carry as a product that will give us the best dollar return, if we do not need for pulp requirements. Incidentally, in our practice of providing pulpwood from second growth stands over the last 20 years, we have been able to realize enough value from sale of high-grade material to offset the value of the pulpwood we used.

In this experiment the purpose in our management is to carry these crop trees through what may be four or five cycle cuts for yield of pulpwood. The effect of such management, as I think of what you've been talking about, is this. Our crop trees have been selected from what you might term the best phenotypes, and these trees are going to provide the ultimate seed source for the next stand. They will be well scattered and they are going to come through perhaps four or five cycle cuts varying from 12 to 15, or even 20 years. In this type of hardwood management we are not worrying at all about reproduction until we make a final regeneration cut, so the seed source is going to be from those trees that have been carried through. We may make substitution for some of the crop tress as the cycle cuts proceed; that is, in the next cycle cut we may find a better tree to leave in place of the tree originally selected. just mention this as a practical application of forest genetics, to improve the forest. Incidentally, it should be mentioned that a climax forest pro vided the seed source for the present stands.

Nienstaedt I think that last comment was very important and I'm glad that it came from a man in the field of silviculture rather than from a geneticist. I think that your words may carry more weight than mine. It is very important that we realize what we are doing if we cut the fastest growing trees in our thinnings. You can imagine going into a stand and cutting your first crop of sawlogs. You will have to get a certain volume out in order to make money and you are likely to cut all the big trees. The result is that you may remove all the faster growing genotypes and you might end up with a seed source that isn't worth anything. Or think of another example You have an even-aged stand and you want to convert it into a selection system of cutting. There again you will go in and cut all your big trees to make openings to start your selection system and again you have no assurance at all that those larger trees are not the trees which have the superior vigor because of a superior genotype.

House Is there any evidence that heredity has much to do with the form and growth rate of white-pine? Has any work been done on that or is any work contemplated? It seems to me that is a field of direct economic importance in timber growing.

Johnson I've been fooling around with white-pine for some time now and do not pretend to know much about them yet. As far as I can see our white-pine is a relatively uniform species in inheritance of growth form. There are differences in height growth, and relative height to diameter growth. This past winter I went down to the area in north Georgia where the white-pine is noticeably slenderer in relation to height and the branches are slimmer, lighter in character and undoubtedly have a tendency to sluff off earlier than in the Northeast. But the species as a whole is relatively inflexible it does not have the plasticity of many other species, as far as I can see.

Sims I am inclined to disagree with the genotypic impression that Johnson has of the white pines in the Toccoa country of north Georgia. I'm a little more inclined to say it is phenotypic, because of the extraordinary good site quality down there. I think we agree that we cannot answer Mr. House's question at this time.

Graves This question of genotype and phenotype is very puzzling to me. I think a good deal of the thing you call genotype may be due to environment. We never can tell how much is due to environment unless, as was said this morning, we have a pure even-aged plantation and certain trees stick

out in that plantation. I know that the genotype is the inherited character, but the question always in my mind is how much of the form of the tree is really due to the environment.

Marvin I would like to say a word about the variation of genotype and phenotype in our maple studies where we have been concerned with an easily measurable quantity such as sugar concentration. We've had a number of stands of different ages, different exposures and so on, and the variability from season to season was at first very confusing. It looked as if it was pretty much an environmental matter, but over a period of years the genetical pattern seems to become apparent. One of the striking things was the great range, and the consistency of this range. We know of the exploitation of genetical difference by our colleagues with agronomic crops, and they are even synthesizing new crops as they want them. But here in a wild plant we found a few trees which consistently were better yielders by a factor of two, than the State average. This is a very appreciable increase and a very encouraging one from our point of view.

Lula The question is certainly a very important one. I intend to go into this tomorrow, so I don't want to steal too much of my own thunder. Certainly the most important question confronting any tree improvement program is the determination of the relative influence of the environment and the genotype with respect to the phenotypic expression of various characteristics. There is no way in which you can go into the field wwere uncontrolled conditions exist, and say this characteristic is rigidly controlled by the genotype or that it is not rigidly controlled. The only thing you can do is to propagate clonal lines of various genotypes, transplant them into as uniform an environment as possible, and then study them. If there are significant differ, ences in various characteristics when they are grown under the uniform environment, then you can say these different genotypes vary genetically. By the same token, you can use similar transplant methods to study the effects ofdifferent environments on the same genotype. You may propagate a clonal line of a particular tree and plant it in different environments. Those differences that appear in the phenotype can be ascribed specifically to differences in environment. Very frequently it is difficult to say what particular element of the environment is responsible, but at least if a particular characteristic varies widely within a single clone under different environmental conditions, you can say this is a loosely controlled character, genetically. This is the basis for much of the fundamental research in forest genetics and in other perennial plants.

Schreiner In this discussion of phenotype and genotype I think we should recognize that for practical purposes we are interested in the phenotype. In our poplar work we have the same clones growing on many different sites. The genotypic growth potential is most closely approached by the growth of the best individual tree of a clone on the best site for that clone. But for practical application we must determine the average growth of the clone under certain environmental conditions. For hybrid poplars we want both values. The average growth on small clonal plots, plots as uniform as possible in their site characteristics, and the performance of the very best tree of a clone on the best site.

Littlefield I'd like to contribute an addendum to the report of my associate, Mr. Cook. Due either to the five minute limitation, or his own modesty, he didn't report that everything he said about larch was

based on personal experience. Dave is a kind of Dr. Jekyll and Mr. Hyde in that for five days of the week he is a public employee and the other two days he is a forest operator, a very unusual thing for a professional forester to be. His forest, which I believe he calls "Cooxrox", is in a rocky spot in Renssalaer County near Stephentown, which through no fault of his own, turned out to be the best larch site in New York. He has already harvested and sold pulpwood, not only from larch species but also from plots of the so-called Dunkeld hybrid. I just wanted to mention that to touch up his comments. He didn't get that stuff out of books, he got it at Cooxrox.

I'd also like to comment on some of the statements this morning connected with disease resistance. There is one little corner of disease resistance which, I think, has been neglected and which would be interesting to follow up on the part of those who are interested in the biological basis for resistance or immunity. In his studies on the Woodgate rust, in the middle '30s, Hitchinson recognized what was already quite evident to us dirt foresters in the field (he not only recognized it, he gave the why of it). He recognized three types of susceptibility to this rust in the Scotch pine population. I think he designated them A, B, and C. I don't recall all the details. The interesting thing, very easily verified by field observation, was an enormous range in susceptibility from practical immunity to almost total susceptibility in that the tree would be literally covered with galls on practically every internode. As a field assistant at that time I had the melancholy job of participating in the counting of the galls on one of these super-susceptible trees--the total was some 20,000. We counted them shoot by shoot, internode by internode and sawed the tree up into its component parts. We got a very intimate exposure to Woodgate rust; it's a wonder we didn't get it ourselves. It was a striking thing because here was one of these trees with 20,000 galls and within a rod or two a tree of the other extreme which, although it was exposed to a most devastating attack of these spores every June, never produced any galls. There were also intermediate types with occasional galls but not sufficient to injure the tree. Hutchinson discovered that the tissues of these resistant trees were extremely susceptible. The reason galls never developed (these infections, incidentally, were all through the epidermal tissues of the new shoot) was that when the hyphae invaded a cell in the new shoot, it was so sensitive to the invasion that the cell ruptured and all the resin came out and literally drowned out the fungus hyphae. In those trees which were extremely susceptible the tissues didn't react sensitively, in fact they did not react at all. The hyphae got in there and became established and you presently had these galls. I think that's something which shouldn't be entirely neglected by the people that are interested in resistance and susceptibility.

Diller During the past quarter century the Division of Forest Pathology has had occasion to test chestnuts of nondescript origin from the orient under forest conditions, hoping to find one that has timber. type form. We followed the suggestion Dr. Pauley made a few minutes ago, of planting them out to see if any of them would develop into forest trees, for we knew that in the orient they were grown principally for nut production and had orchard--tree form. From 1936 to 1939 we established 21 Asiatic chestnut "climatic" test plots in 8 states. Some 22,000 trees were involved, planted 8 by 8 feet on an aggregate of 32 acres of forest land. We found that of the many kinds tested

one Chinese chestnut always shows up better than all the rest as a forest tree. Although the period of testing in the plots is only from 1936 to 1952, actually we have two earlier plantings of this Chinese chestnut established in 1926. Trees in the two plantations, one in Delaware and one in North Carolina, measure 60 feet in height and 8 inches in diameter, and exhibit high natural resistance to the chestnut blight. We feel we have good genotype material to work with, and are using it right along for breeding purposes.

Gabriel I think it might be well to put this genotype-phenotype business in the language of foresters, for the benefit of those individuals present who may not understand these terms. Probably the best way to do this would be to use an illustration. Let us assume a situation in which we have two adjacent trees growing on an extremely poor site. Both trees would develop at the same slow rate into relatively poor specimens. Should we transfer these trees to a uniformly better site and one tree outstrips the other in growth, we could say their genotypes are different with reference to growth rate. The genotype of a tree is carried internally and usually represents the characteristics inherited from its parents. It carries the potentialities of the tree, i.e., growth rate, form, branching habit, etc. The expression resulting from the interaction of the genotype with the environment is called a phenotype. In the first situation the factor for rapid growth rate was masked by the poor environment, but on the better site this potentiality was able to assert itself, resulting in a larger, faster growing individual. The better site would make no appreciable difference in the growth rate of its inherently slower growing companion.

Baldwin Are there any suggestions or questions from some of the industry men present? I think that is the thing we should not lose sight of. It's been the influence that has sponsored tree improvement progress in Sweden and in the south and possibly some industry man here would like to be heard from on this subject.

Parrish I'll throw out a little food for thought that might be of interest to this group. Perhaps you can do as we have in the Forest irodducts Research Society which I happen to head up here in the northeast. That is, on commercial developments to recognize and differentiate between what the advertising publicity may claim, and the authenticated facts. I was thinking that perhaps your group might have a Committee as we have in our organization, for instance on adhesives and finishes, that takes up some of the new things that appear on the market. As an example in your field, I have here something that is of interest to me. This happens to describe a new vinyl horticultural aid. Its nothing different than your regular method of propagation by air wrapping except this claims it has a hormone, vitamins, nutrients, trace elements, insecticides, fungicides, printed on the vinyl film. "By this new air layering method 5 to 10-year-old trees are said to be produced in only 5 to 8 weeks." Then it goes on to say that trees and plants that have never been rooted before can be handled by this method. It seems to me that if this is right you can take a limb as big as your wrist to start with and in 4 or 5 weeks you have trees growing. I'll just hand this over with the suggestion that you establish a Committee to debunk any of the things that need it.

Schreiner I would like to refer to Professor Doran's paper. He brought up the point that it's not only necessary to be able to root cuttings but we must also know whether the rooted cuttings will grow into normal

forest trees. In 1940 my former colleague, A. G. Snow, Jr., rooted white pine cuttings at our Experimental Forest here in Williamstown. About 150 of these rooted cuttings were eventually out-planted at our Beltsville Experimental Forest in Maryland to observe their growth and form. I examined these for the last time in the summer of 1951, and at that time, at about 11 years of age, they probably represented the oldest plantation in existence of white pines propagated from cuttings. At 11 years these rooted cuttings had grown as well as seedlings and their form was just as good. I went back to look at them last January and found that someone had stolen them all, apparently for Christmas trees. That experiment is finished, but we did raise some nice straight 12-year-old trees from cuttings.

Professor Doran also mentioned that you can root some cuttings, but its difficult to carry them over and keep them alive the second year. Marvin and Taylor have had the same experience. They can get sugar maple cuttings to root but by the time the roots are formed the cuttings are dormant, and apparently do not build up a reserve to carry them over the next year. Some researchers in Europe have been using additional light in the late summer to extend the growing period of cuttings. Extending the length of day on maple cuttings after they are rooted in late summer may be worth trying.

I don't think we should be discouraged on this question of cuttage. We need to try same completely new methods. I'm quite sure there isn't a tree species of which we can't root at least one cutting. If we can root one cut ting, then the problem becomes a matter of rooting them on a commercial basis cheap enough to use for planting stock.

Hans Nienstaedt mentioned mixtures of clones. I would like to point out that the Dutch quinine growers in Java built their entire industry on a mixture of clones. The scion-wood of the famous Ledger stocks, which had high production capacity, was taken from nursery stock raised from seed from clonal seed orchards. The plantations were therefore mixtures of literally thousands of clones. They didn't do that to get clonal mixtures; they did it because the Ledgers wouldn't survive on their own roots. I suspect that their successful quinine culture stemmed largely from the fact that it was not practicable to propagate a single clone. If it had been possible to grow Ledger clones on their own roots, they might have started growing only a very few of the highest producing clones with serious trouble from diseases.

Lockard Perhaps I can shed a little ray of hopefulness on this time angle mentioned by Professor Doran, this 42-year business. One of the things I have wondered about is how you tell when you've got a good clone. If for example, you're breeding ash for toughness, how long do you wait before you know you're going to have good tough wood? We've had some discussions on that at the Forest Products Laboratory and the ray of hope is that at the Laboratory they believe they can evaluate wood characters in the hardwoods at a relatively young age. They can't tell from branch wood but they can from small stem wood.

Heit Nothing has been mentioned yet about checking on some of these plantations the boys told us this morning were planted 15, 20, 30 years ago. I'd like to throw in a thought here that this organization might dosomething or might stimulate the proper authorities to check on some of these plots. I helped establish some of those plantations and took many notes on seed characters years ago and it seems a shame that something isn't done about these plantings.

In this connection I would like to tell an incident which happened a year or two ago at the Geneva Experiment Station. A gentleman from Pennsylvania called on me, and has written me a couple of times since then, about seed source of pines and where he can get seed so the trees will grow a certain way and conform to a pattern. he is particularly interested in Austrian pine and Scotch pine for Christmas trees. He apparently had been down to Pennsylvania State College several times and couldn't find what he wanted so they sent him up to the Cornell Forestry Department where he was directed to the College of Forestry at Syracuse University and conferred with Professor Harlow who sent him to me. When he came in the door he said, Is your name Heit?" I said, "Yes." "You're the man I've been looking for--I understand you're the only man in the United States who can tell me what I want to know." You see the run-around a fellow gets when he is trying to learn something. He explained that years ago he put in a Christmas tree plantation of Austrian pine. These trees grew perfectly, well shaped, bushy and had short needles. He sold all of them for a premium price, around $3.00 per tree. They were all cut now and there weren't any more of that seed source around. All the people in his section thought Austrian pine was the tree to plant for Christmas trees and now they are rather disappointed. These trees have long needles, poor form and are not bushy. He came to me with this question, "Where can I get a seed source that will produce more short needle Austrian pine trees?" I couldn't answer him either. He got me interested in the problem and as I'm also trying to grow a few Christmas trees, I started collecting from individual trees and have written to several places in this country and Europe. I haven't got the answer yet. My point is that possibly some of these questions could be answered if these older plantations had been followed year after year as a research project rather than forgetting them for 5, 10, 15 or 20 years.

Bramble Maybe I'm the fellow who sent this Christmas tree grower up to New York State. It just shows what a run-around a grower gets when he starts looking for information on genetics. He had a lot of problems. He wanted a slower growing tree, a pine that only grows about a foot a year so he doesn't have to shear it to hold down the growth. He also wanted to know how to recognize races of Scotch pine when the seedlings were one year old.

I think one of the biggest problems we have in this work is to quickly supply a demand for seeds of superior races. Right now we want seeds of Douglas fir for the growing nursery industry in Pennsylvania. We want them this fall. The only way I know to get that information quickly is to search for geographic races. For example, in Douglas fir we have the three geographic races or variety. Sometimes they are very distinct although often you can look at all three of them in the same plantation and can't tell them apart. We're getting these geographic races from what we think is the center of each territory, putting them in the nursery under uniform conditions where they do show up very differently in growth rate. We then plant them in various parts of Pennsylvania on uniform sites to see what the differences will be when they are growing in various parts of the State. Granted we are working with a mixed population from each of these centers of seed collections. In our, nursery, for example, we are growing the three varieties in a uniform nursery bed. The green comes up in about two years and makes a beautiful seedling 18 inches tall. The other two varieties are only L or 5 inches. Last year the green variety was winter-killed back to about 4 inches. If we had gotten one or two trees or a group of them that hadn't been winter-killed, which we didn't, I

suppose we could have had a genotype that was frost-hardy and we could have started off on something. But as I see it we face the possibility of many years before we get local seed produced, perhaps 30 years as a generous estimate. What we're faced with is finding a geographic locality in the west from which good seed can be obtained with a high proportion of good individuals. We don't want every individual perfect. If we find a good source perhaps we can buy seed from there in the future.

As to this Spanish Scotch pine, I just got a shipment of seed from Spain for the Christmas tree growers, with the help of Dr. Pauley and Ernie Schreiner. We are going to try it out. The seed is certified from the Spanish source as being native Spanish seed. We'll try to grow it in our nursery and plant it over the State under various conditions. One of our big problems is going to be that gap between when we find the race or variety we want and when we can get seed from it out to the growers.

It takes quite a while to raise seedlings of hardier racesof Douglas fir. We're interested in whether there is any place in Pennsylvania where the green variety will hold up. I think there is. We have very satisfactory 3-year-old blue seedlings grown in drills in our experimental nursery. We can't get nurserymen to do that. They like to broadcast the beds, so they get thousands of small seedlings per bed, and don't thin them out enough to produce good planting stock.

Heit You can get good 3-year seedings broadcast if you control the density.

Bramble Even with the best spacing however, you get tremendous differences in growth rate between the green and blue in seedbeds.

Heit With proper seed bed density and fertility you get good growth with any blue variety I've ever seen.

Taber Perhaps I can suggest an answer. If you will get seed from the San Isabel National Forest in New Mexico, not in Colorado, I think you will have your Douglas fir problem answered. We have tried in our nursery the various varieties from the coast and from the mountains and we have finally settled on the San Isabel seeds. It is a blue and we are growing it 12 inches to 18 inches tall in two years.

Now, I've been listening here most of the day. I have thought there might come out of this conference some piece of machinery within the framework of the conference whereby we who are out in the field, finding a particular strain or tree that appears to be better, can make arrangements for vegetative propagation of that tree with the idea that the person who recommends it will carry on the experiment after he gets from the propagators a sufficient quantity of plants. I offer that as a suggestion for consideration of the conference.

Now apart from that we have a particular propagation problem that has its economic facets in the case of bald cypress. Only about four percent of the bald cypress seed is reliable and produces economically collectable seed only about once in 6 or 7 years. I am wondering if the people who are engaged in that work here today might not evolve a more economic way of producing our needs in bald cypress planting stock than we now are able to do with seed. We must sow seed from about a bushel and a half of cones on 200 square feet of seed bed from which we get maybe 1800 seedlings. Now it seems to me that the cost of producing cypress planting stock could be cut considerably if a satisfactory vegetative propagation method could be devised for this species. That

also goes for some strains of tulip trees.

Baldwin Its now 4:40. Are there any more comments or discussions?

Recknagel We have a distinguished visitor here, its a real privilege to introduce to this group. Mr. W. R. Adams who is our Vice-President in charge of all pulp and paper production. Bill, will you take a bow?