FOREST TREE IMPROVEMENT IN THE SPRUCE-FIR REGION

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As Ed Giddings has pointed out, we have little need for planting in the spruce-fir region. Under even the crudest sort of silviculture we get natural regeneration of commercial species. Thus the use of new hybrids, select races or superior progenies derived from outstanding parents in forest seed orchards is for the most part not feasible.

What we need is a type of genetics that will supplement our silviculture. A working tool that the forest manager can use just as he uses his knowledge of silvics, soils, entomology and other basic or quasi-basic sciences. This calls for knowledge of how the principles of genetics work, both in theory and as applied to our forest species and stands. We could then modify and improve our silvicultural techniques, making use of recognizable inherited characteristics, and adjusting the stand to improve those characteristics that are responsive to environmental change.

I should like to point our a few of the specific problems that would confront us in bringing tree improvement to the spruce-fir forests. And then I'd like to suggest a possible approach to those problems.

It might seem that since natural regeneration is the common and desirable means of perpetuating our timber crop, then the goal of the practicing forest geneticist is a simple one: to work toward superior seed trees, just as is done with other species. However, cur forests are most effectively managed under a selection system of silviculture. This means maintenance of uneven-aged structure, and retention at all times of a substantial growing stock. We do not liquidate our entire timber capital at any one time. Thus there is no point in talking about "leaving seed trees" in the ordinary accepted sense.

Furthermore, our silvicultural objectives do not call for reproduction to come in all at once. On the contrary, we want a continuing seed supply of all our valuable species over the entire forest in order to maintain the uneven-aged structure. It might be suggested that by the use of genetical knowledge and experience, the trees that are to produce this seed be carefully selected for this purpose and preserved in the stand as long as possible. The trouble with that is that seed production could not be restricted to a group of elite seed trees. Balsam fir and white spruce start producing viable seed at a small size--at 3 or 4 inches if the crowns are in the sunlight. Red spruce and hemlock begin a little later, but sail a long time before they reach the maximum economic size of 16 to 20 inches. In the typical situation, therefore, an average acre over a 10-year period will be showered with upwards of 50 million viable seed from at least a hundred seed-bearing spruce, fir and hemlock. The contribution of a dozen or so selected seed trees would represent a small part of the whole.

Yet it is just a half-step from this idea of developing superior seed trees to an approach that not only should have much more, and much earlier, practical value in our region, but also should ultimately give us a high quality seed source.

This approach hinges upon the fact that good management in the spruce-fir region nearly always calls for the selection system of silviculture. Now let me take a moment to make quite clear what I mean by "selection" system. I don't know of any tern used in forestry that has been so atoned, misunderstood and made the subject of claims and counter claims. Actually it should be--silviculturally speaking--a process of stand improvement as well as a system of harvesting merchantable timber. It is not a high-grading process. It does not result in the repeated removal of the best trees and a consequent decline in the genetic quality of the forest. Properly applied it selects the trees to be kept and not the ones to be cut. I think we'd have a better understanding of the real objective of the selection system if we foresters would begin thinking and talking about _retaining_ growing stock, and stop talking about leaving it, as though it were something nobody wanted.

At any rate, let's consider the selection system a positive means of improving the quality, structure, composition and rate of growth of the spruce-fir forest. It requires a fairly short cutting cycle--preferably not over 25 years. It pays little attention to rotation, and--in the early stages of management at least--takes reproduction pretty much for granted. It is most effective when supplemented by improvement cuttings of an investment nature: thinning, removal of culls, release of good trees, and so on.

The typical spruce-fir forest managed under the selection system has an uneven-aged structure. With a 20-year cutting cycle, at the time of any cut, the trees that comprise the next cut are nearing maturity. The trees that will make up the next three or four cuts beyond that are already in the stand also. The forester most work with what he has.

He has two objectives: to make his periodic harvest operation a profitable one, and to build his forest for the future. While there is usually some conflict between these two aims, they are by no means irreconcilable. For his harvest cut he takes out the largest trees, and the more poorly formed, slower growing and less valuable trees in the smaller sizes. Insofar as his silvicultural efforts for the future are concerned, his goal is to select and retain for added increment the fastest growing, beat formed trees of the most desirable species in the riddle and lower merchantable size classes--i.e., from 6 to 12 or 14 inches.

For this selection process he relies upon recognizable external characteristics mostly: long crowns; slender branches; healthy, vigorous foliage of good color; long terminal and lateral shoots; little taper; freedom from defect; lack of deformity. Such trees that are still immature or below the maximum economic size are kept for fast, high quality growth whenever possible.

But to maintain proper density and spacing in his forest, he must also keep a large number of other trees. And in the first few decades of management on any tract the bulk of the growing stock consists of average trees: individuals that are now rather limby, growing rather slowly, of indifferent form and only moderate vigor. In making his keep-or-cut decisions among these trees, he must mentally project the growth and development of each into the future. Will it prune itself naturally? Will it respond to release? Can its present rapid taper be reduced by giving the tree more head room? Will it be resistant to insect and disease attack? He is on uncertain ground now. He does not know of any way to identify at this stage a potentially good genotype. Nor does he know how far be can Co toward improving this segment of his growing stock by adjusting the environment of individual trees.

At this juncture we are right in the middle of the field of genetics. You will recognize, I am sure, that the stage is set for mass selection: the gradual improvement of the duality of the forest by continual selection on the basis of apparent quality. This technique is slow and its success depends upon the judgement of the forester in selecting Food genotypes, and especially upon his ability to distinguish between the effects of heredity and of environment. This approach is the one best adapted to the improvement of natural stands that are to be handled under a selection system.

With this as background, there are, it seems to me, two ways in which the science of tree improvement can be brought to bear on the forester's problems by giving him an additional working tool to supplement his silvical knowledge.

In the first place he should be able to recognize desirable genotypes when the tree is relatively small. This would permit him to take advantage of its superior characteristics now. He would assure himself of a crop tree (not just a seed tree) that is clean, straight, sound, resistant to insect and disease pests, and one that will reach maturity in the shortest possible time. He would not have to wait for that tree to produce seed, which would produce superior progeny, which would finally give him quality wood production. He has by-passed the first two stages.

At the risk of belaboring the obvious I want to be sure to make a distinction here. Schreiner has stated (Journal of Forestry, January 1950) that the practical forester will need criteria for judging excellent breeding quality, which means improving a future generation of trees. This is true, of course. But he is first interested in improving his present stand, so as to realize the highest and best quality yields possible from its genetic make--up. It is not enough to he able to pick good seed trees.

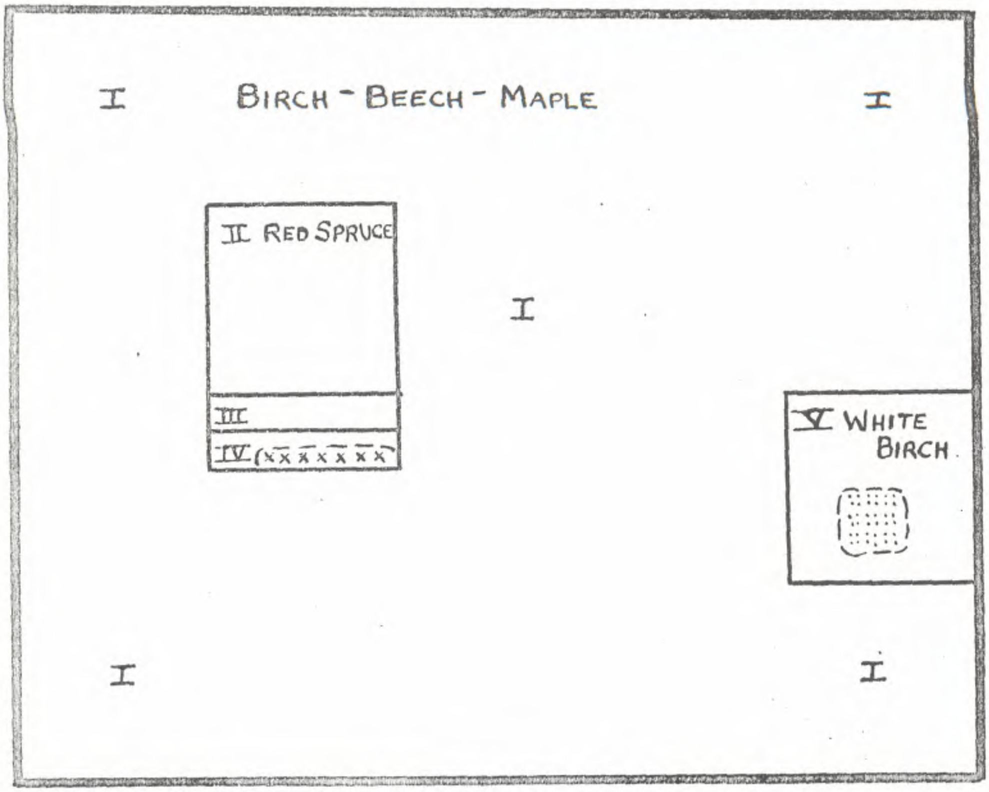
I assume that forest gen eticists can recognize in a mature tree, for some species at least, those desirable characteristics that are probably inherited. But how early in the life of a tree can such characteristics be recognized? If the forester were able to identify superior genotypes of spruce, fir and hemlock when they are 4 to 6 inches d.b.h. he would be able to do a far more effective ,lob of improving his growing stock than if he has to wait for the trees to reach matur ity and then tries to introduce genetical methods into his management program.

I should like to quote a short paragraph from a paper by Clemens Kaufman which appeared in the September 1954 Journal of Forestry. Kaufman says, "Many of the factors which single or in combination are used by foresters to identify crop trees and seed trees are known to be genotypic and to vary within species. Among these are vigor, crown and stem form, amount of natural pruning, resistance to diseases and pests, and wood quality." That's fine. This is the sort of information that could be of great value to the practicing forester in our region if the genotypic characteristics can be recognized early.

Put Kaufman goes on to say, "Environment has a marked influence on these factors also. D ifficulty arrow when efforts are made to separate one kind of influence from the other." And this leads to the second way in which genetical methods, or rather genetical knowledge, can be put to use in the forests of the spruce-fir region.

The mature spruce or fir tree ready to be converted to pulpwood is (to quote Schreiner again) "the end product of the reaction of a particular genotype over a long period of years to a changing complex of environmental conditions." So the forester must riot only be able to recognize the best genotypes, he must also anticipate what effect environment will have upon a genotype.

DIAGRAM ILLUSTRATING AN IDEA FOR PRACTICAL GENETICS WORK ON MANAGED FORESTS



W.H.MEYER 1955

LEGEND

ONE SQUARE INCH EQUALS 100 ACRES

BOUNDARY OF 2000 ACRE FOREST

TYPE OR COMPARTMENT BOUNDARIES

I BIRCH - BEECH - MAPLE (HIGH PERCENTAGE SUGAR MAPLE)

II RED SPRUCE (PURE)

III MIXTURE OF I AND II

IV LIKE I BUT WITH ABOUT 20 GOOD RED SPRUCE PER ACRE

V WHITE BIRCH (PURE)

(X X X X) GENETICS PLOT - SCATTERED SPRUCE ABOUT 10 ACRES - 20 RED SPRUCE PER ACRE

GENETICS PLOT - SCATTERED ASH ABOUT 10 ACRES - 20 WHITE ASH PER ACRE

On the basis of this sequence of premises it follows that the forester should understand how and to what extent both heredity and environmental influences may be controlled and directed by silvicultural techniques; or, in other works, by the adjustment of stand conditions. If, for example, natural pruning is strictly an inheritance factor, the forester need waste no time trying to induce better pruning by manipulating spacing in the stand. The success of silvicultural operations aimed at improving the quality of the growing stock will depend to a considerable degree on how much is known ahead of time of the results that may be expected.

As Ed Giddings indicated, the silviculture practiced in most of the spruce-fir region is still somewhat rudimentary. But times are changing. In another 5 years the knowledge, judgement and skill of the forester will exert a much greater -influence on the way our forests are cut than they do now. The research, man should be apprehensive that he may not be ready with the information the forester needs when he needs it.

Considering that we will always be dealing with natural stands, the geneticist may feel that his influence for a long time to come will be so indirect and diluted that it is hardly worth his time to bother with us. I hope not. The field of opportunity for what Kaufman calls the extensive application of genetics by the silviculturist will be developing rapidly before long. We should be prepared for it.

DISCUSSION

Chairman We have ample time for discussion of any and all of the papers.

Meyer I don't know how practical my idea will be but I think that the practicing silviculturist and woodland manager might be able to use it. On quite a few state forests or industrial holdings, it should offer possibilities.

We could assume that this area on the blackboard (Diagram on facing page) was a two thousand acre block and we could also assume that the largo portion was the birch-beech-maple type leaning heavily to sugar maple. The smaller compartment (II) is pure red spruce aid V is practically pure white birch. Now applying impractical field genetics I would think that it might be possible to take a strip just below the area of transition from spruce to hardwoods. The percentage of spruce in this strip might be relatively light--just a few trees per acre. On such forests where such strips could be selected, it should be relatively easy for the manager to scout them thoroughly and choose the better individuals that he wanted to leave to produce seed. All other spruce on the strip could be cut and on such a small area it would not be hard to modify the silvicultural treatment so that he could get more spruce reproduction in the immediate vicinity from the better seed trees.

Practically the same thing could be done in the white birch type where a few white ash might be available, and in other areas where the species and other conditions were suitable or rather favorable.

If the geneticist could give us ideas on picking the type of trees that we should select, I believe that the woodland manager might have an opportunity to practice "real genetics" on a small proportion of his forest. The cost would not be too great and over a period of time with these study plots, we might be able to gather quite a bit of interesting information.

I think that this suggestion also ties in with the last point on our program "What do you suggest that NEFTIC might do to advance forest tree improvement?". I think that if this organization could give the practicing forester some ideas on tree selection in booklet form, that we might get somewhere with this procedure to advance forest tree improvement.

Chairman I've heard landowners say it is cheaper to cut these seed trees and plant because you're leaving too high a volume of wood on the ground. It's worth, we'll say, $40 an acre that you're leaving and you could plant that acre for $12 or $15. It's true you can go back and take these trees out, but going back is a costly proposition. And I'm just wondering from what I've heard here the last two days if we aren't better off to plant, providing we can control the seed source. In other words, are we getting better seedlings on the ground by planting than we would be by just a chance of seedfall from selected seed trees?

Raup Last night we were talking about the feathering out of some of these opened stands. Do you know any rules for choosing the trees that are going to put out these branches and those that are not?

Ehrhart I don't know of any proven rule for so choosing. Under the particular circumstances that exist in the secondary experimental area of our crop tree plot, where everything except the crop trees was removed, we find considerable difference in the amount of epicormic branching, and in its location on the bole. We can recognize that crown breakage, such as occurs in ice storms, is an important factor. Also we recognize the necessity of a heavy exposure to light if branching is to occur. Without question, other environmental factors are involved. But how to identify all the factors, or how to give them proportionate weight is going to be a difficult problem. I think a couple of the slides I showed last night gave comparative examples of results. Here was a tree that branched out, and there was one that didn't under seemingly identical conditions.

Raup We have the same problem in our area, particularly since the hurricane of 1938 when we had a great many maturing trees that were opened up. Some of them have produced epicormic branches in profusion and others, equally in the open, have not done so. We have not been able to find any local site differences to account for this, and I wonder whether any of those who have thought of the problem in terms of heritable characters have any opinions about it. Ed, was this 10-acre plot square?

Ehrhart Roughly triangular in shape, just enclosed by a road system.

Raup Do you have tree by tree measurement on that plot?

Ehrhart We do now, Hugh. Originally we just had a tally of the diameters. I don't think we could trace them exactly back to the original point but since that time we have identified the individuals by numbering.

Raup. What I was wondering was whether you see any differences in the growth rates from the center to the edge of those plots. Do you have any data that would show it.

__Ehrhart__ You always have to expect, I think, a differential along the margin as a result of what has been done around it. Now at the same time that we initiated this 10-acre plot we also had a pulpwood cutting on one side of it and later on two other sides of it that resulted in approximately the same opening for light intensity. Consequently, the perimeter may be expected to have like conditions as the whole plot. However, in the particular area of two acres that we clear-cut except for the crop trees, for the purpose of a regeneration study, we set up an acre as study plot and then cut another acre in similar manner around it as an isolation strip.

One other thing I might mention too, in connection with sprouting or branching, that we are attempting to explore. Where we have cherry trees that are undesirable in form, or that we would not hope to use for anything else but pulpwood, there is a possibility of inducing sprouting before felling the tree by a partial saw or axe cut at stump level. During this past year we've been trying to find out something more about sprouting; when most of it occurs or if there is some limitation of time. We're taking a certain number of trees each month and we're putting a saw cut a few inches from the ground and just run in through the sapwood. Many of those cuts within a month or two of the growing season have induced sprouting. Part of that experiment was to find out if we can start a better formed tree from the same root system. In other words, give the same tree a new chance under changed environment. In my paper I pointed out that the original forest had perhaps two percent of cherry in it. Now that holds true quite as much by volume as by number of individuals. So the seed source for all the cherry we have, had already been through a very rigorous selection of some kind of environment. Therefore, we're inclined to think that a wolf tree is more likely to be the result of the immediate environment rather that of genetical influence. If this is true, then any of our cherry stumps that sprout have potentially good values.

__Raup__ I wondered what you were doing in regard to root competition. We've been doing some experiments in the Black Rock Forest on the influence of root competition and it becomes quite obvious that a single operation changes the behavior of the root just the same as it does the crown of the tree. We need some experiments that will amplify this thing and I was wondering whether there might be something in your plots that could be used in that way.

__Ehrhart__ It's possible, Hugh. I feel that it is very difficult to isolate root competition from let's say light or moisture competition, and to define the effect of each on the result. Now what we are trying to watch is what sort of opening we need to get accelerated growth and to determine the time period after which we have to come back and release again before we get a slowing down. I have a few figures here from this crop tree plot which show in bulk those trees which we marked on the 10 acres. I would say that most of those crop trees were of intermediate nature in the first place, simply for the reason that natural competition had given them not only clear, slim stems for quality increment, but also compact crowns to withstand possible damage by ice and snow. Now in the first period of 43 years the annual increase in diameter of these crop trees was 0.167 inches. The initial cut of 22 cords to the acre, made in 1940, was an exceptionally heavy cut and really did take out everything that was merchantable other than the crop trees. During the first six years after this cut, the rate of diameter growth almost doubled, to 0.317 inches. We didn't have year by year figures on that so we can't tell how it changed but in the next four year's the rate increased from 0.317 to 0.350 so that it had not yet reached its peak until the second half-decade following the cut. In the period 1950 to 1955 the rate has slowed to 0.22 from 0.35 resulting from a closure of well let's call it both crown and root; I don't know of any practical way we could isolate the proper weight of each. We recognize the result, it's there. I think we have to assume some sort of balance to exist. Perhaps some of our experiment stations can tell us, or try to find out where that balance is between root competition and crown competition. In the meantime we grope in the dark and we try to keep a middle path by an open mind.

Raup Do the veneer people have any limits as to how fast a tree can grow and still produce good veneer. That is, how much could you whoop up the growth of these trees?

Ehrhart I don't think there's a limit for cherry. Much of this cherry that is serving for veneer today has been the fastest growing cherry that has occurred since the clear cutting of the old climax forest. I don't think we need to assume a limit, because the wood texture remains the same throughout the growing season. I might mention we have a certain plot that we set up in connection with some state work back in the early twenties, on a good growing site of primarily hard maple and black cherry. We had severe ice storm damage in 1936 which meant clear cutting a great deal of forest land. The plot was in a second growth stand that in 1936 was between 50 and 60 years of age. We cut everything that was on it excepting those trees which were too small to use and which incidentally had not been damaged very much. It was surprising how those few small trees of let's say 5 inches and under have closed in, and there was some cherry sprouting; from stumps in the same area. I went back just recently to check on an observation and I found one cherry stump that had developed multiple sprouts only one of which finally took over. That individual sprout in those it years had grown to a diameter of 8 1/2 inches and 65 to 70 feet high.

Hansbrough Do you get much damage in logging?

Ehrhart A lot of residual damage depends on the type of operation you have. On our better sites we intend to get full accessibility if we possibly can. On this particular site and many more like it we have done that by actually laying out a system of feeder roads, not more than 100 feet apart. Now that isn't really a road but it's a cleared strip that stays that way because you've compressed it by traveling over it and because the closure is quick around it, and that affordsus some entry so that we can pick up any tree without having to skid it. If you can produce your pulpwood in wood length and handle it by hand, load it right on the truck or dray to take it out, your residual damage is practically nil. Just as soon as you start to tike a tractor into the woods to skid out tree lengths then you run into damage. In answer to your question I think it's a question of what equipment you use and how.

Hansbrough Do you think you can keep damage to a minimum, where it is a factor?

Ehrhart I think so. We have been trying all these different things, and we've been coming pretty much to the conclusion that where we can improve our accessibili ty due to good growing site, I mean where it's warranted, that's the way we're going to operate. If a site is poor and inaccessible what's the use of paying a whole lot out trying to improve it and only get two or three tenths of a cord per acre, where somewhere else we can get a cord or a cord and a quarter. We try to select the sites for intensity of operation so that we'll get the benefit of cheaper operation on our better growing sites.

Littlefield (Not recorded. Reference to clear cuttings and plantings.)

McLintock I agree with Ed there. The feasibility of planting following clear cutting depends a lot upon the species and types you're dealing with, the kind of ground cover, and the nature of the natural reproduction. Where we have rather shallow, glaciated, rocky soils planting is a problem anyway even if the area is clear to begin with. In the second place, except for inter- and under-planting, a planting program following cutting presupposes clear-cutting which would eliminate seed source as well as any reproduction already established. Dot such cutting immediately introduces a new successional stage of raspberries, hazel, alder, grey birch and other junk. This represents a very severe handicap to any planting program. So in our country we believe that natural regeneration is the best approach to perpetuating our stands.

Raup May I ask a question of both Tom and Ed. They both used the terms uneven-aged stand. Do they really mean that as truly uneven-aged or just many-aged.

McLintock That's something we don't know; something we are just starting to find out in our research work. To be sure we have talked rather glibly about all-aged stands and uneven-aged stands and so on, but we do have evidence that in most of our stands we don't have a one-storied structure. And we know that in cases of a tolerant species like red spruce, it may be represented, and usually is, by all stages from the new germinated seedling on up to the mature tree. Insofar as other species are concerned, however, we're not so sure. The more intolerant cedar, paper birch and red maple, and possibly even the tolerant balsam fir, may occur in even-aged patches. I'd rather say many-aged than all- or uneven-aged, but it's so mething we just don't have much information about yet.

Raup When we say that a stand is uneven-aged there's an implication that it has grown without disturbance for a long period of time and has become uneven-edged. Sometimes they have, as you mention of the spruce, but I wonder how much of it is the result of the things that have been done to the stand by cutting and fire and so on.

Harsbrough I was rather interested in Tom's comments, particularly in that he threw out the idea that among other things the silviculturist, the forest manager, needs trees that are resistant to decay. Now, in Dr. Zabel's discussion of this subject yesterday he brought out the point that we do have variation in susceptibility to decay within a species. We know that it occurs and we certainly should do all that is possible to increase the percentage of heartwood-resistant trees in our stand but there is another angle. All of our decay studies in forest trees have shown that without exception there is a definite relationship between age and decay regardless of this individual variation between trees. There is always a definite relationship of age and decay in a stand so I think that for the forester to expect us to give him a disease or decay resistant tree is part of the thing but not all of it. Through management, by fitting his rotation and his cutting cycle to the pathological rotation of the tree, he can do a great deal to decrease decay losses without any particular selection for disease or decay resistance. I want to leave that as an idea. Don't depend entirely upon the geneticists. Let's depend a lot more upon good forest management. The two can go hand in hand.

McLintock I want to emphasize the same thing. Ed Giddings and I both mentioned that, speaking primarily of balsam fir which is our number one problem tree as far as decay is concerned. It surely does qualify as a silvicultural problem, simply because it can be corrected by the application of good silviculture. The immediate problem is to harvest the fir before it gets old enough to have serious decay. But back of the harvesting problem, is a more basic one; to thin out the thickets when they are small and keep the fir growing rapidly from an early age. But it has occurred to us at numerous times that there might be strains of balsam that are more resistant to decay than others, and if so we should find out whether there is any practical way of taking advantage of this resistance.

Schreiner During the late 1920's I worked in Cape Breton, Nova Scotia, where the fir was slow growing, old, sound, and dense. It had even been described as a hybrid between spruce and fir because of its density and apparent decay resistance. I personally have seen balsam fir trees in Cape Breton 150 years old that were as sound as a dollar. The lack of decay may be due to climatic control of the fungi, or to inherent resistance.

Hansbrough We know not only in balsam fir but in aspen, two species highly susceptible to decay, that the farther north we go the rate of decay over age certainly does decrease. We can grow both balsam fir and aspen safely on a much longer rotation farther north than we can farther south. What I don't know, and what no one has done, is to bring seeds or trees from those northern sites down farther south to see if they are genetically resistant to decay. I rather doubt it. I imagine that it's a reflection of climatic differences.

Schreiner I am inclined to agree that it's probably an environmental effect, either directly on the fungi or indirectly on the growth response of the trees.

Chairman We've been trying for several years to grow the northern balsam in our nursery for planting on higher elevations, and it just will not grow. It dies out in a year, so the only balsam we're using now is the West Virginia balsam, Frazer fir. That scorns to do fairly well, but not under 2500 feet. Plant it down below that and it just seems to kick out, except in a few isolated places.

Hansbrough Plant breeders have informed me that the secret in successfully moving any plant species either northward or southward is to do it gradually and select individual trees that are genetically best suited to the new habitat. Given time and careful attention, I believe it would be possible to select a race of balsam fir that would grow well as far south as Maryland.

Hamilton On occasion, in black cherry stands which have been rather heavily cut, I have noticed increased gum production on the residuals. I wonder if you have observed this on these plots which have been so drastically treated?

Ehrhart If someone here could tell us just why gum spots occur, perhaps we could speculate on your question. In the first place the botanists tell us without question that gum spots are due to injury. If you can figure out what type of injury causes gum spots, fine. The only thing I can think of that perhaps gives a clue, is the fact that almost invariably these gum spots occur during the tail end of the growing season. This leads me to think that it may be frost injury. In other words, while the cambium is still active we may have a hard early frost. Gum spots may occur com pletely around one annual ring or may occur in spots on the same ring. Cherry bark is thick at one place and much thinner at other spots, where the creases occur. I hope to collect some evidence that will enlighten us on that possibility, but to date that is the only theory to which I can attribute gum spots. There will be a way perhaps of checking this theory if we can get specimens from different places and check with gum spots against weather records. I hope to get a little done along this line but we don't have an intensive research department to follow through on such things. If it's worthwhile for some of the experiment stations to find out, this is a lead that I think they might follow.

Hamilton In view of what you say, perhaps what has been termed "sunscald" should be investigated as a possible culprit, it increases when the stand is opened up.

Ehrhart There is some relation to the location. One of the things that I think of as a particular reason why perhaps some trees in some regions, some locations, are freer from gum spots than others is that there may be a genetical difference in how long the growing season for that individual lasts. We do notice differences in individuals. You were showing last night, Ernie, some pictures of maple trees when the autumn coloration occurred. We have some of them that occur two or three weeks ahead of some others, and I notice that year after year maybe one tree doesn't start to color up until a week or two after another one that's under the same environmental conditions. So perhaps there's a genetical strain there that shortens the growing season and so makes it less susceptible to frost damage, because it has stopped growing before a killing frost occurs.

Heimburger I have some comments on northeast spruce-fir forests. Mr. Giddings in his talk said that we don't know what an elite tree looks like. Well if we don't know what it looks like we should have good wood's superintendents who could tell us. A ctually I don't believe we know, I think we should know as foresters and if we don't we should be ashamed of it.

Another thing, we should make up our mind on what we want. Twenty years ago we could not use hardwoods in the northeast very much and Westveld and his associates wanted to step up spruce production. At that time balsam fir was less desirable than spruce and the recurrent budworm outbreaks emphasized the fact that sruce is more desirable, being a more budworm firm species than fir. We should make up our minds even from a genetic standpoint whether we should continue improving spruce or whether we should in certain localities do some work with balsam fir. Another thing which is very often in the foreground is hardwoods vs. conifers because in the old days we transported all our wood by water. Gradually we are building more and more roads and we can get at hardwoods by truck and get them down to the mill and the mill can use them. Now, does it want to use them? Some mills don't want to use them and it is not equally desirable to use all the woods. We can use all woods but we don't want to use all kinds of woods. We can eat all kinds of meat, in a famine we can eat skunks and woodchucks and even rats, but we usually don't do that. Now, in a wood famine we also would be able to use anything we can get across. But if we manage our forests properly we should not get a wood famine. We should keen the wood supply up and we should make up our mind which kind of wood is more desirable from an all-around standpoint and decide to do genetics on these species.

Hough I suppose a research man should not go out on a limb and offer more observations and hypotheses, but I do have a few observations on black cherry with regard to epicormic branching, sprouting and gum spot. Regarding epicormic branching the opening up of a stand by a heavy cut does seem to induce the proliferation of those so-called water sprouts or epicormic branches. The only species I know of in the type which does not produce epicormic branches on opening up is a white ash. Ash has very little epicormic branching. The buds are under the bark, they're dormant, the bulk of them are of such nature the bud trace goes clear to the heart, the center of the tree as shown by dissections.

Now on sprouting there's such a thing as apical dominance, the highest bud which starts to develop seems to dominate the others. Some plant physiologists could probably tell you something about the auxins affecting shoot growth. The higher the origin on the stump the greater the susceptibility to decay. Now this is unfortunate but possibly it can be remedied. Maybe we can induce sprouting low on the stump since high on the stump the band of sapwood is narrow and rot progresses from the heartwood of the stump into the new sprout. In high-origin sprout the juncture between heartwood which develops in the sprout and rotten wood in the heartwood of the stump is readily bridged over. There is also a good chance that physiological heartwood will form even in this sapwood and that rot will then enter the new sprout. Now, we don't know too much about the progress of rot. It seems to be rather slow in cherry and so it is possible that sprouts can be used to produce pulpwood, perhaps in some cases veneer logs. Personally I would rather work with seedling growth. I have a few observations on that but time wouldn't permit right now.

With respect to black cherry gum spot, there is some evidence that insects are involved. I believe possibly climatic reasons can be the initiating factor but I have seen many of these gum spots with frass of insects in them; I have dug out insects from beneath this frass and gum. *A very* small insect, the peach tree borer, or a related native insect, possibly is the cause of that. Climatic factors in gum spot are exposure to sun and top damage by glaze. Observations I made in 1936 following the glaze storm, indicate that trees which have had part of their crowns stripped out produced numerous gum spots during the spring of the following year. There was no evidence whatsoever of frass in these fresh gum exudations, which covered, the trunk clear up to 30 or 40 feet in the crown of young second growth trees. In older black cherry trees, which have been exposed to the sun by cutting and which stand near buildings occupied since 1932, I have often noticed gum spots especially on the south side of the tree. There may thus be two or more causes, crown damage, exposure to sun and various insects. There are a lot of leads to follow as to the cause of gum spots.