weeks They will callus in the moss and even begin to initiate roots Six weeks from the middle of February brings you to the end of March. At that time, take them out in the ordinary frame and set them upright in sandy soil, shut the frame down tight and water them often. Give them a little shade and they will root practically 100 per cent without any heat.

MODERATOR STEAVENSON: Thank you, Jim, for your comments.

About the nicest thing that happened to me when I got Martin's program was to pick it up and notice that my old sidekick was going to be on this panel here this afternoon. Our next speaker, two other men in the audience and I started out together. I hate to say the date, but it was exactly 25 years ago in the Conservation Service. I would like to introduce the third man who is here, who started with Thor and I, Al Dodge, please stand up The fourth culprit, who I am mighty happy and proud to see here is Art Slavin. To me, and to all of us it is like old home week after these 25 years to get back together again.

Our next speaker, as I mentioned has the fancy title of "Woodland Conservationist." He tells me that is a fancy title for forestry. Thor Bergh has operated a large seedling nursery for many years. He has been in commercial nursery work and he has been engaged in various types of forestry and woodland practice, principally in the colder lake states area. He is exceedingly well qualified for the topic that he is going to discuss, namely, will seed from Northern plants produce harder plants than those produced from seed collected in Southern regions? Thor Bergh!

MR. THOR K BERGH. As you said, this is very much like old home week with the four of us back, and not only that but I have met several other fellows here that have made my stay so far a lot of fun. I expect to have a lot more pleasant experiences before I leave here.

Mr. Bergh presented his paper on the affect of seed source on hardiness of plant material

WILL SEED FROM NORTHERN PLANTS PRODUCE PLANTS HARDIER THAN THOSE FROM SOUTHERN REGIONS

THOR K. BERGH
Woodland Conservationist
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Mr. President, Mr Chairman, members of the Society and guests. It is a real challenge to present a talk on a subject that, I am quite certain, is very familiar to some of you, probably most of you Not only is this a challenge but also a distinct honor for me and for the Soil Conservation Service, the agency that I represent, to have the privilege of talking to you today.

The title that was assigned to me is "Will Seed From Northern Plants Produce Plants Hardier Than Those From Southern Regions?".

This may be a controversial subject. I am sure that some of you feel that you have an answer to that question.

Many of my comments will stem from my own experience, some from work of colleagues, and some from work of others about which I have read or heard.

With your permission, I may deviate a little now and then from the subject of hardiness and swing occasionally into the subject of adaptability. They seem to go together, and it is often difficult to discuss one without also mentioning the other.

As you know, the use of seed is only one way of many ways to propagate plants. To some of you, it may be a minor part of your propagation program. Many of you are in the field of ornamental plant propagation. My work takes me primarily into the field of soil and water conservation, in which field we have greater interest in plants of utilitarian value, rather than ornamental.

If you are in the field of ornamentals, you are actively engaged in propagation by budding, grafting, layering, and rooting, as well as seeding. As a matter of fact, many plants that you grow may require that you first make a seeding to produce root stocks to which you will later plant a bud, or graft a piece of scion wood.

Many plants used for ornamental purposes are also propagated and grown to saleable size, direct from seed. Concolor fir, noble fir, several spruces, notably Colorado Blue, the pines, some *Taxus,* junipers, cedars, to name a few of the evergreens can and are propagated from seed.

The list of deciduous trees and shrubs that are grown from seed is long and very important.

Certainly every man here has a vital concern in using good seed — seed that will produce a plant that will be hardy and adapted to the site and be completely adapted to the conditions it will encounter when it is planted in its ultimate location.

To us in the north country, one of the characteristics a plant must have, of course, is hardiness. But, in addition to that, it must be adapted to other factors. These factors may be such thing as soil texture and pH, conditions of wetness and drought, competition, insects and diseases.

In growing plants from seed, th most important consideration the propagator must keep in mind — once he has decided what species to grow — is the source of his seed.

Even for the propagator who makes a conscientious effort to obtain good seed, it is often difficult to obtain seed of known origin, true botanical identity, or of known age, purity and viability. The propagator who does not require proof of origin is gambling, and the consequence may be costly, not only in money expended for poor seed, but in time lost.

Europe has gone through the evolution. After bitter experiences many European countries have enacted rather strict laws regarding the use of forest tree seed. German seed dealers voluntarily submitted to regulations of seed import as far back as 1906. Later, German law required certification — by appointed forest officers — of stands of trees

and even individual trees, before seed could be collected. Additional measures which have been adopted or brought into being by law are, the adequate labeling of all seed as to origin, restrictions of the movement of seed within the country, and heavy import duty on foreign seed. America has lagged behind in this matter of seed certification of trees and shrubs.

The United States Department of Agriculture has adopted a policy regarding forest tree seed. This policy could well be adopted for all seed, including those used by the propagator of ornamentals and fruits.

It may be well to make it clear that this policy applies only to seed and nursery stock used within the U. S. Department of Agriculture, and is in no way to be construed as federal legislation regarding these matters.

This policy, if followed by all propagators, however, would go far toward promoting the proper use of seed of known origin. The pertinent parts of this policy read as follows:

"Recognizing that trees and shrubs, in common with other food and fiber plants, vary in branching habit, rate of growth, strength and stiffness of wood, resistance to cold, drought, insect attack, and disease and in other attributes which influence their usefulness and local adaptation, and that such differences are largely of a genetic nature, it shall be the policy of the United States Department of Agriculture, insofar as practicable, to require for all forest, shelterbelt, and erosion-control plantings, stocks propagated from segregated strains or individual clones of proven superiority for the particular locality or objective concerned.

Furthermore, since the above attributes are associated in part with the climate and to some extent with other factors of environment of the locality or origin, it shall be the policy of the United States Department of Agriculture:

1. To use only seed of known locality of origin and nursery stock grown from such seed.
2. To require from the vendor, adequate evidence verifying place and year of origin for all lots of seed or nursery stock purchased.
3. To require an accurate record of the origin of all lots of seed and nursery stock used in forest, shelterbelt, and erosion-control plantings, such records to include the following minimum standard requirements to be furnished with each shipment:
   - (1) Lot number
   - (2) Year of seed crop
   - (3) Species
   - (4) Seed Origin:
     - a. State
     - b. County
     - c. Locality
     - d. Range of elevation
   - (5) Proof of origin
4. To use local seed from natural stands whenever available unless it has been demonstrated that seed from another specific source produces desirable plants for the locality and uses involved. Lo-

cal seed means seed from an area subject to similar climatic influences and may usually be considered as that collected within 100 miles of the planting site and differing from it in elvation by less than 1,000 feet.

5. When local seed is not available, to use seed from a region having as nearly as possible the same length of growing season, the same mean temperature of the growing season, the same frequencies of summer droughts, with other similar environment so far as possible, and the same latitude.
6. To continue experimentation with indigenous and exotic species, races, and clones to determine their possible usefulness, and to delimit as early as practicable climatic zones within which seed or planting stock of species and their strains may be safely used for forest, shelterbelts, and erosion control.
7. To urge that states, counties, cities, corporations, other organizations and individuals producing and planting trees for forest, shelterbelt, and erosion-control purposes, the expense of which is borne wholly or in part by the Federal Government, adhere to the policy herein outlined."

A similar policy on all seed could become a reality if the buyer of the seed would demand that his seed dealer provide adequate data as to origin of seed.

To summarize this policy, you will recall that it recognizes the fact that trees and shrubs, as well as all other forms of plant life, vary in many ways. Although my topic has primarily to do with hardiness, we can hardly talk about the ability of a plant to resist cold, without also bringing into the discussion these other items of adaptability that influence their usefulness and value to those of us who propagate them and use them.

It is well known to all of us that a single species of plant may include a great diversity of unique varieties, forms, races and strains. Considerable research has been carried on in recent years to try and determine the reasons for the development of these variations within a species Basically, however, the greatest influences in the development of these variations are climate, soil conditions and site factors.

There is a great deal of work that still needs to be done to determine the existence of these variations within species, and also to learn the range of these plants.

At the present time, we do know a few things about these variations or races within a species

First of all, we know that, in all likelihood, most species of plants that grow under a variety of climatic and soil conditions have developed variations in one or more of the items we listed earlier, such as branching habit, rate of growth, hardiness and resistance to drought, insect and diseases.

We know also that as the climate of the place of seed origin increases in warmth and mildness, susceptibility to frost and snow damage increases; resistance to certain fungi increases and rate of growth in-

creases. There is a tendency to form thicker stems and larger, more well developed crowns Fruit and seed size increases.

As an example, we can point out a few species that have developed definite variations with the range of the plant because of differences in climate, soil and site.

In the case of our native Minnesota red pine, we know of a least three races that differ in frost hardiness. Siberian elm has several variations. In the case of this particular tree, the lack of knowledge regarding seed source on the part of nurserymen, caused a great deal of trouble some 20-25 years ago. Millions of plants were produced and sold as "Chinese elm." Actually, this was Siberian elm, *Ulmus pumila,* but the seed was gathered from trees in the southern portion of its natural range in the country of its origin They proved to lack in hardiness in our northern areas. The tree developed a bad name, and to this day, we still suffer from the old prejudices. Today, we still have available to us, from nursery sources, several races of Siberian elm. The difference is that they are now largely from northern hardy seed sources, and the plants are perfectly hardy. It will take years, probably a new generation of Americans, to completely forget the bad taste for the old so-called Chinese elm Even among our northern hardy races of Siberian elm we have variations in growth rate and size. Some of the northerly strains are named Chinkota, Manchu, Harbin, Dropmore, and there are others.

Another example is Scotch pine Here we know of at least five races. In the seed catalog of one of the better known seed dealers, there are listed no less than eleven seed sources of Scotch pine, all of them supposedly different in one respect or another. Each of the five recognized races differs in their degree of hardiness, growth rate, growth form and habit Some other common plants where more than one race exists and where there is a difference in hardiness are western hemlock, southern slash pine, Engelman spruce, Sitka spruce (which, incidentally, has five recognized races), white spruce and many others, as well as several common deciduous species, both of native and foreign origin.

For example, I notice three so-called races of European larch listed. The dealer describes the first one as coming from the Eastern Alps at elevations of 3,000 - 4,200 feet, the second one from the foothills of the Eastern Alps at 1,200 - 2,100 foot elevations.

The third European larch listed is from the Western Alps at 6,000 foot elevation. The description goes on to inform the buyer that this particular larch has a late starting and early terminating growth, is cold and wind resistant, and grows tall, straight and very fast. Here we have a recognition on the part of this seedsman that there are variations within a species, and he has gone to considerable effort to tell his customers about them

This is commendable, and it is only hoped that in years to come, we can be provided with reliable data on all variations of all species of plants, in order to make the propagator's job easier and the ultimate user more satisfied and happy

Norway spruce is another interesting item in this particular catalog. This catalog describes eleven sources of seed and provides a great deal of information to help the buyer to decide which one is best for his use and locality.

This is all very good, and a move in the right direction because, as of today, there is no exact way of determining racial origin of a plant on the basis of seeds or young seedlings.

The purchaser of seed or stock must depend chiefly on the certification of the collector or dealer.

Another interesting subject regarding seed, the seedling and the adult plant has to do with variations in seed size, seedling development, stem form and general structure of plants growing in the same area For example, two plants of the same species and similar age growing side by side may show considerable difference in the size and weight of the seed they produce. Seeds from the same tree may vary a great deal There may also be considerable variation in resistance to rust, mildew, insect damage, etc.

Some of these variations may have to do with resistance to frost damage. There is very little experimental data to support it, but observations seem to indicate that this is true.

Suffice to say that in regard to plants of the same species growing together in the same area, it is important that even here the seedsman pick his seed plants and gather seed only from individual plants having the most desirable characteristics of branching, foliage, growth, resistance to frost, drought, insect and disease.

How many of us have taken a bundle of tags and gone out to a nursery block or to a scion block or a group of plants anywhere to tag plants that show superior attributes regarding good foliage color, good growth form, beautiful flowering habits, heavy fruiting of large individual fruits and for other desirable characteristics. I can recall such things as a shrub having heavy leaf mildew, and its next door neighbor having little or none at all; the caragana bush that is completely defoliated by blister beetles, and its immediate neighbor untouched by the beetle.

At this point, we may start to ask some questions as to "why." Just why is it that the plant grown from seeds of the same species growing at opposite ends of its range are so different in respect to hardiness Why is it that we cannot take white pine seed from Illinois, for example, and expect the seedlings to be hardy in Northern Minnesota? Why can't we take seed of Siberian elm from its southern most range in Southern China and expect the seedling to be hardy in the northern portion of its range — Northern Siberia?

This brings us quite naturally into the physical and chemical make-up of seed.

A seed is a rudimentary plant or embryo — a young plant. It is composed of seed-leaves, a bud, a stem and roots. It is a plant in miniature.

Usually associated with this embryonic plant is some stored food and a protective coating.

From the standpoint of handling seed, three types should be considered. First, there is the true seed which can be readily extracted from dry fruits or cones. This includes most conifers, the pod bearing plants such as locust, and the capsule producing plants such as the poplar.

Second, we have the dry fruits such as the nuts of oak and chestnut and the fruits of maple and elm.

And third, we have the fleshy fruits such as honeysuckle, plum, walnut, mulberry and apple. These seeds can be used without cleaning, altho, in most cases, the fleshy portions are removed to leave the inner seed for easier handling.

None of these seeds can be used to propagate new plants, of course, until they are ripe. As the seed ripens on the plant, a series of physical and chemical changes take place. These changes, especially the chemical changes, are very complicated and little understood. Fortunately, the chemical changes are usually accompanied by readily observed physical changes such as changes in color, taste, odor and texture. Thus, unripe seed that is green, dry, sour and bitter becomes yellow or reddish, juicy, sweet and many times edible.

Other seed such as those dispersed by the wind change from green to tan or brown; the seed coat bcomes darker and harder, and the meat of the seed becomes less milky and more firm. The seed is then fully developed.

To the layman or the inexperienced, one could now assume that this fully developed ripe seed is ready and able to germinate. However, this is not necessarily true. A substantial majority of seed will not germinate immediately, even tho the conditions may seem ideal.

Before germination can take place, two conditions are necessary.

First — The seed must be ready to germinate.

Second — The external factors must be favorable.

Some ripe seeds will germinate and grow at any time, providing these two conditions are provided. They are not many in number of species, but do include some of the legumes, some species of alder, some of the poplar, willow, and even some of the pine, as well as others.

In the cooler regions of the world, however, most of our seeds become dormant immediately after they become fully developed and ripe. This is especially true of those that ripen in the fall of the year.

In order to survive, all living creatures must adapt themselves to their environment. With winter and killing cold weather coming on in late fall, it certainly is not to the best interest of a species of tree or shrub to permit its seed to germinate soon after it falls to the ground.

What would happen if seeds did not go dormant. The young plants, sprouting from the germinating seed, would succumb to frost, and there would be no progeny.

Seed of willow, poplar, some elm, and others are fully developed and become ripe early enough in the season so that they have ample time to germinate and develop into a fully mature seedling before the first frost, so we have no problem here.

In this business of plants adapting themselves to their environment, there also are degrees of adaptability. Coming back to white pine we can illustrate this degree of adaptability. It isn't necessary for white pine seed produced from a native white pine tree in Illinois to go dormant for so long a period of time as a white pine seed produced in northern Minnesota.

Why? Because the winter is of shorter duration in Illinois and, in this case, the white pine has adapted itself to the shorter winter, and thus a shorter dormancy period for the seed.

If a Minnesota white pine seed and an Illinois white pine seed were sown side by side in the forest litter of northern Minnesota, the Illinois seed would probably die, because it would germinate during the first intermittent warm spell of the spring. The Minnesota seed would wait and not permit germination until later on when the weather became favorable for seedling survival.

A little later on, I want to go one step further and consider the plant that may be produced by these seeds of northern and southern sources, but before we get into that, let's explore this business of seed dormancy a little further.

As we stated earlier, seed dormancy is common, and frequently very important in the survival of the species. It is most common in northern climates and is very closely related to the climate of the area where the species in question is native. Generally speaking, seed of the same species from southern portions of its range may, and usually do, have a shorter period of dormancy as already illustrated in the case of the white pine seed. During this period of dormancy, the phenomena of what we call "after-ripening" takes place. "After-ripening" is a process largely of chemical change in the seed. Conditions of proper temperature and moisture must prevail in order that after-ripening progresses satisfactorily.

There are variations here too. Some seed require a period of warm temperatures, followed by a period of cold temperatures, before its after-ripening processes are completed and the seed permitted to germinate. In addition to this, some seeds may have an impervious seed coat which prevents moisture from entering the inner portion of the seed. There are many other complicated combinations of conditions that are necessary before the seed in question will germinate at the wanted time, or, for that matter, germinate at all. For example, no one has satisfactorily solved the seed dormancy problem and the conditions that are necessary to bring about germination of Basswood seed. Let us consider, however, the most common and most easily overcome of seed dormancy problems. Once we have discussed these more complicated aspects of dormancy, after-ripening and germination can be reviewed

One of our most common problems of dormancy and after-ripening is found with most of our northern conifers. Many other plants have much the same problem. Essentially, we can say that after-ripening takes place during a period of cool temperature and in the presence of moisture.

In nature, this need is satisfied by the parent plant dropping the seed to the ground in the fall, where, if it is lucky, it finds a favorable seed bed. The seed lies dormant until spring when thawing warm weather arrives. Then, and not until then, the seed germinates. The conditions, in this case cold temperatures in late fall and winter, along with moisture in the seed bed provided by fall rains and winter snows — have been met

Now, if we, as nurserymen and propagators, do not or cannot seed in the fall but for some reason find it necessary to make our seeding in the spring, these conditions of temperatures and moisture must be supplied artifically. In this business, we call that "stratification" This is a tricky business, however. It is relatively easy to provide these conditions, but the degree of temperature, the amount of moisture, the media in which we stratify, and the length of time required before after-ripening is completed is a big question and a major headache.

Now, seed source comes into the picture again. Unless we know the source of our seed, we cannot possibly know how long a period of time the seed will lie dormant in stratification before the after-ripening process is complete, and the seed is ready to sprout

Many of you, no doubt, have had the experience of having seed sprout in stratification long before you expected it to sprout, and long before you were ready to use it. This may be due to the fact that you got a batch of seed from a source more to the south than you had anticipated.

In using southern seed, therefore, we are running a risk of seed germinating too soon in the spring.

The next consideration is the seedling or plant produced from this southern seed. Let's assume we are lucky and successful in producing a seedling from this seed It grows vigorously all summer and goes into the fall season. Through generations of growth, the ancestors of this plant have adapted themselves to southern conditions. Now for the first time, this one year old seedling finds himself in the colder north country. The growing season may be 25 days shorter, and the first killing frost comes 15 days earlier than he and his ancestors had adapted themselves to endure. He is not ready for frost. He has not "hardened off" as we call it. The growth on this plant is still soft and succulent. He suffers frost damage, freeze-back. He is said to lack in hardiness. There are other characteristics by which a plant may display a lack of hardiness during the winter months and during periods of extremely low temperatures, but this fall period, with the early killing frosts, is one of the most critical periods of all What happens in the fall that cause us to say that a plant lacks hardiness? It is rather a simple story.

At this particular time of year, a plant lacking in hardiness, a southerner, continues to grow. The tissue remains soft. Plant cells remain filled with cell fluid. The first heavy frost freezes this fluid; the fluid expands as does frozen water in a bottle, and the plant cell is ruptured as is the glass bottle when it is full of water and frozen.

In contrast to this, a hardy plant of the same species but of northern parentage has adapted itself to slowing its growth in the fall, hard-

oning the tissue, reducing the moisture in the plant cell, and thus is ready for the fall frost. It survives because it is not injured. This adaptability to freezing conditions in the fall is one characteristic of hardiness. Native seed from your own local native plants are adapted to your conditions Seed of the same species from more southern sources are not.

There are many other complicated factors regarding the many species of seeds and plants which I do not have time to discuss today. Suffice to say at this time, almost every species of seed has its own peculiarities and characteristics of dormancy, periods of after-ripening and necessary conditions to bring about germination at the wanted time.

For the successful propagator, these characteristics and treatments must be familiar to him

I once produced some plants of Norway spruce of central Indiana seed source The after-ripening period required was several weeks shorter than that of Norway spruce seed from old trees in southeastern Minnesota By growing them in a protected spot, using a minimum of nitrogen fertilizer, and eliminating irrigation in late summer on the droughty sand site, we were able to bring them thru as four year old transplants. It's risky. We shipped them back to their home state for planting.

We once produced American elm from southeastern Minnesota seed and planted some of the stock in northwestern Minnesota. It proved to lack in hardiness and killed back in varying degrees every year, largely because of early fall frost damage For plantings in northwestern Minnesota, we now advocate the harvest of northwestern Minnesota seed. These are common but typical examples.

And now to get back to the original question. "Will seed from northern plants produce plants hardier than those from southern regions?" The answer is, of course, "Yes."

The hazards encountered everyday by every propagator are too numerous anyhow, without asking for more trouble, especially those troubles that we can avoid I think it is of prime interest to all of us in this business to insist that seed sources be made known to us, and further, that we use only those seeds that will produce the finest stock, perfectly hardy in the area where they are to be ultimately used, and adapted to the conditions they will find there

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MODERATOR STEAVENSON: Very fine, Thor.

Who has a question for Thor Bergh?

MR. BEN DAVIS: We have quite a problem with our seed in that we get it in the fall, clean it, put it in cold storage for stratification and they sprout sometime before the weather is favorable for planting.

MR. BERGH: Well, I suggest that the way to solve that problem is to stratify your seed at different times of the year. Eventually you will find what the satisfactory time of stratification is. It may be 90 days, or it may be 120 You won't know until you actually try it out. It may be that you could seed them in the fall and then you wouldn't have to worry about them.

Your experiment station in our own state may also have information that will help you

MR. DAVIS: Well, sometimes we have had things sprout as quickly as 30 days after we had stratified them. We don't know how to prevent it. If we could store them dry, it would solve our problem. You can't let pear seed dry out, as I understand.

MODERATOR STEAVENSON: Do you have a 32 degree storage?

MR. DAVIS: No, not too close to 32 degrees. We have cold storage in which we stratify our seed but we also keep bare root stock there, too, and it usually runs about 35 to 40 degrees.

MODERATOR STEAVENSON: If you can get some temperature pretty close to freezing when you see evidences of sprouting, you could put your seed in at that temperature and hold it almost indefinitely.

MR. DAVIS: I might add, last year we tried putting some in quick freeze, and we didn't get one single seed to come out.

MR. DAVIS: That quick freeze thing worked on *Rosa multiflora* and we thought it might work on *Pieris,* although it didn't

MR. HOOGENDOORN: What is wrong with seed when all of it doesn't sprout the same year? Some magnolias will come up the first year and you may even find some coming up the third year. You also will find that some of the seed of *Juniperus virginiana* will come up the first year and some the second. What happened there?

MR. BERGH: I haven't had much experience with magnolia but there are some seeds that may have a protective coating on them, and the degree of thickness of that coating may vary with the seed. As a result you may have seeds coming up the first year and you may have some seeds coming the second year In the case of *Juniperus virginiana,* one of the things that we do to assure germination of the seed, after fall seeding is to clean them very thoroughly and get that waxy coat off the seed. Not only that, but we have collected the seed early in the fall before it actually became dead ripe and with early fall seeding we have obtained 100 per cent germination the following spring.

MR HOOGENDOORN: What about magnolia?

MODERATOR STEAVENSON: Thor, I would like to comment on Case's question. Nature doesn't form these seeds for the convenience of the nurserymen but rather she builds them for the preservation of the plant. For example, a batch of seeds will be sprouting for 20 years. This is nature's way of spreading out the progeny so the species has a better chance of germinating and reproducing its kind during a favorable season. There are many plants such as holly, cedar, and hawthorn which react just as you describe. All you can do is hope to germinate the greatest number.

MR. HOOGENDOORN: One way I have tried to overcome it with *Juniperus virginiana* is to keep it in a bag until the beginning of August. This is then stratified until the spring. By holding it over and stratifying it in August you get all the seed germinating

MR HANS HESS· I have a comment to supplement what Case Hoogendoorn has just brought out. We, like Case and many others, have had the same experience with seed of juniper and of American holly, that is, partial germination the first year with the bulk of the seed coming up the second year We have found that by holding this seed over and stratifying it around February or March, that if there is a small amount of germination the first season we just forget about it. When we sow the seed the following season we get the bulk of our germination the following spring

I would like to ask one question of the speaker. Have you had any experience on the results of bringing northern seed into southern areas?

MR. BERGH: Of course, that is the opposite of bringing southern seed to the north, but I think it would be a poor policy to bring any species too far south out of its range. For example, take the case of Northern Red pine. I think possibly it would not be advisable to take plants of Norway pine too far south out of its natural range, although there are places in the south, like Missouri, where some Red pine has been planted and it looks all right. However, as this U.S.D.A. policy states they feel that you should stay close to the natural range of the species that you are considering.

DR NELSON: May I comment on pear seed germination? I might say that at Ottawa we don't keep our pear seed moist. We let it dry out and put in dry storage. The greatest influence on the effectiveness of stratification on pear seed will be entirely dependent upon the moisture content of the stratification medium. There is a further complication here in that there is a difference in performance of seed produced in good seed years and poor seed years, which is dependent on the weather at blossom time. If you have unfavorable weather at blossom time you will have to add at least two weeks to the stratification period and about 25 per cent more moisture That sounds like a lot. Where in one case we use an even weight of moisture and peat moss we would have to go to say 120 grams of water to 100 grams of peat moss under another set of conditions.

MODERATOR STEAVENSON: Thank you, Stu.

PROF. J. C. McDANIEL (Urbana, Illinois): I have a comment on the matter of holly seed germination. The technique has not been worked out completely but it sounds promising and I thought worth mentioning to this convention. In our department someone brought in some trees of *Ilex cornuta* He harvested some seed last September and soaked it approximately ten days in a weak solution of household lye. When the seed was softened he washed it with vinegar, sowed it outdoors and it came up. Ordinarily *Ilex cornuta* won't come up for nine or ten months at the earliest In this treatment he got uniform germination the first spring.

MODERATOR STEAVENSON: Thank you. Mac I believe Bill Flemer has a question

MR. FLEMER: In answer to Hans Hess' question, I would say as far as shade trees are concerned we at Princeton Nurseries like to get northern seed sources rather than seed sources farther south, from New

Jersey This gives us a much longer digging season. For example, if we plant sugar maple seed from Vermont the trees go into dormancy about two weeks earlier in the fall and they are sometimes three weeks later in coming out into growth again in the spring. This gives us a much longer time when we can handle the trees in the dormant condition as compared with seed from locally grown maples. If we get seed from Tennessee sugar maples the situation is disastrous, since they never stop growing They pop out on the first warm spell in the spring. From a nurseryman's point of view, it is more advantageous if you can do so, to get seeds from further north than the location of the nursery.

MR. FRED NISBET: How do your customers like that for the next 50 years?

MR. FLEMER: They don't care because we have to sell all over the country and we can't very well sell New Jersey sugar maples in Vermont and we certainly don't want to sell New Jersey sugar maples from Tennessee. The trees are just as nice but they do have the shorter spurt growth in a shorter period of time.

MODERATOR STEAVENSON: We have time for perhaps one more question.

MR. HARVEY GRAY: I wonder if the speaker would make a comment on stratification in polyethylene bags where the seed has been moistened and then put into bags at a favorable temperature.

MR. BERGH: We tried stratification in polyethylene bags, as you say, and we can't say whether it was good or bad We had fair germination with some species On some we got no germination We felt that probably stratification with some medium such as we have always used was a little better in some cases because of these coatings on the seed which may be eaten away by the action of the acid in the medium or something of that kind I don't think I can say as far as my experience is concerned as to whether or not it can be substituted for the old-fashioned method of stratification

MODERATOR STEAVENSON: We use polyethylene bags almost entirely for stratification. However, we use a medium with the seed before putting it in the polyethylene bag. The big advantage is that you don't have to be watering your box all the time.

MR. GRAY: The reason for that question, Hugh, I believe it was in Forestry Planting Notes that this has been cited as a practice for Loblolly pine, which would indicate it was quite a successful manner of treatment I was wondering if this might be carried over to other types of coniferous material.

DR. NELSON. I haven't had a great deal of experience with coniferous material but with apple, germination is reduced to about one-half. When we wet the seed itself and set it under high humidity, cool temperature conditions we got roughly 40 per cent germination However, with peat moss at a one to one peat moss-water mixture before we sealed it up, we had up to 80 to 85 per cent germination.

MODERATOR STEAVENSON: Al Dodge, would you take just two minutes to make some remarks? Al is in charge of the U S D.A., Plant Introduction ornamental work in the North Central Region.

MR. A. F. DODGE (Ames, Iowa): Out lots of cedar are quite small, and I will go along with the use of polyethylene bags with a moderate amount of medium with the seed.

MODERATOR STEAVENSON: The last speaker of the afternoon is Mr. Rodney Bailey, Vince Bailey's nephew, and Gordon Bailey's son. He has been handling the nursery propagation the last couple of years. We are fortunate that we have Rod here with us to discuss "Over-Wintering of Softwood Cuttings under Controlled Temperature," which I know they have been doing a great deal of work on. Rodney Bailey!

Mr. Rodney Bailey presented the discussion on the procedures used to overwinter softwood cuttings in a controlled temperature, nursery storage.

OVERWINTERING OF SOFTWOOD CUTTINGS UNDER CONTROLLED TEMPERATURES

VINCENT K. BAILEY
J. V Bailey Nurseries
Dayton's Bluff Station
Saint Paul 6, Minnesota

The present day propagator has been given the knowledge, through recent research, of how to root softwood deciduous cuttings at a low cost This know-how has been spread by our universities and such organizations as the Plant Propagator's Society We have all cut our costs tremendously by adopting these new methods.

I feel that the propagators work does not stop at putting roots on a cutting. If he can not produce a finished plant economically, he is soon in financial trouble in this very competitive world. The transfer of this rooted cutting into the field has been a challenge to all of us. Many are getting good stands by placing them in bands or pots for a time and then transferring them to a field. There are a number of variations of this procedure but it is very costly in time and labor.

In order to reduce this high labor cost, we started six or eight years ago to transfer these rooted cuttings directly into the field. We were well satisfied with the results in all ways The stands were good and growth was surprisingly vigorous. The storage over winter was in trays packed in peat. Several years ago we tried storing in polyethylene in a modern refrigerated and humidified cooler. I give you this background for our experience to point out our reasons for searching for a better method of getting the finished plant at low cost.

Following is our procedure that we have found to be most economical for producing quality stock. The plants are allowed to mature naturally in the mist beds or the greenhouse benches. Probably one of the reasons for our success with this method is the attention we give to the proper hardening off of this rooted cutting. In my estimation, nothing will take the place of this natural process. The chemical defoliants or mechanical means of leaf removal reduce the vigor of the plant to some